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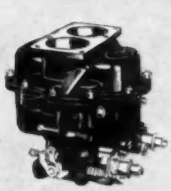

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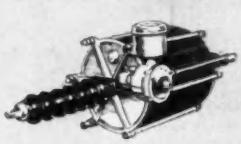

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Record AERONAUTIC MEETING Spurs Plane Mass Production

ENGINEERING problems of mass-producing aircraft, currently for war uses and ultimately for extended peacetime purposes, passed in swift review before the SAE National Aeronautic Meeting in New York April 8 and 9.

Nearly 1000 engineers attended the 10 sessions, took voluminous notes on the addresses of 23 speakers, and participated in prolonged technical discussions of pertinent engineering subjects from aviation engine testing to wood aircraft design. Further, they gave an enthusiastic welcome to a comprehensive engineering lecture on helicopters by Dr. Igor I. Sikorsky.

Directly practical, informative, and inspiring, the meeting made helpful contributions to aeronautical engineering progress, created new engineering concepts pointing the way to important future developments, among them:

- Helicopters, supplementing airplanes and automobiles, bring man closer to the goal of universal transportation.
- Utmost in airplane performance can be obtained only by proper combination of airframe, engine, and propeller – a job of co-designing.
- Fatigue failures result only from tension stresses, every surface raises stresses, and repeatedly stressed surfaces are more vulnerable to fatigue than deeper layers.
- Techniques of measuring the temperatures and stresses under which component parts of aircraft engines operate open the door to intelligent improvement of design.
- Initial *production design* of aircraft incorporating consideration of mass-production presages potential production vastly greater than even present manufacturing methods and proposed increases in plant capacities indicate.

The concluding session, which filled the New Yorker ballroom and overflowed into the balcony, produced for Dr. Sikorsky's lecture and colored motion pictures, as well as for the versatile helicopter, an ovation which swept forward from the back of the hall as the film ended, and rolled ahead in a swell of applause bringing the capacity audience to its feet. It was evident from the time that Herbert Happersberg, representing the SAE Metropolitan Section as host, opened the meeting and introduced William Littlewood as session chairman, that the engineering mind was receptive to the subject of helicopters.

SAE President Mac Short, commending the contributions of the SAE and its sections and committees to engineering progress, was enthusiastically received. Prior to the concluding session, President Short and Dr. Sikorsky were guests of honor at a reception given by Chairman Littlewood.

Wright Award to Strang

The enthusiastic audience gave a roar of approval also to the presentation of the Wright Brothers Medal to Charles Romain Strang, strength engineer, of Douglas Aircraft Co., Santa Monica, Calif. The medal is awarded annually for a paper which, pre-

SAE President Mac Short, Vega Aircraft Corp., left, chats with Dr. Igor I. Sikorsky, Vought-Sikorsky Aircraft Division, speaker at the closing session of the SAE National Aeronautic Meeting, New York, just before the latter addressed the closing session on April 9. With them are Herbert Happersberg, Brockway Motor Co., Inc., chairman of the Metropolitan Section, host of the meeting, and William Littlewood, American Airlines, Inc., who was chairman of the final session

sented during the year before an SAE meeting, in the opinion of the Board of Awards represents the most outstanding contribution on aerodynamics or related subjects. Mr. Strang's medal-winning paper, "Progress in Structural Design through Strain-Gage Technique," was delivered at the SAE 1942 Annual Meeting in Detroit. Accepting the medal, Mr. Strang said he regarded it as recognition of the entire work of the large group engaged in developing strain-gage methods.

Every Spot on Earth Made Accessible by Helicopter

The helicopter supplements the airplane, makes transportation truly universal, and enables man to reach every spot on earth, however small or inaccessible.

Those are the real missions of the helicopter, in the opinion of Dr. Sikorsky, who explained that he had built his first models without knowing how to construct a direct-lift plane, and had attempted to fly them without knowledge of the technique of helicopter operation.

"That first model was good, except that it wouldn't fly," he said. "Number Two actually got into the air. Number Three achieved the maximum of standardization – take-off, flying, and landing speeds all just about equal to the stalling speed – but it proved the helicopter could operate in a small space."

Asserting that the airplane has made tremendous progress and has to its credit such accomplishments as making transoceanic travel really safe, Dr. Sikorsky added that the plane had failed in the respect of demanding excessive space for taking off and landing, a characteristic in which the helicopter is superior. He pointed out that the plane began by using a county fair race track as airport, but now requires the whole fair ground. The result of this development, which he characterized as "backward progress," is that the airplane must operate from huge, distant, and inconvenient airports, an objection which the helicopter has succeeded in overcoming.

The five elements of the plane – body, engine, propeller, landing gear, and wing – are reduced in the helicopter to three – body, engine, and propeller. The helicopter admittedly has encountered fundamental troubles in development, among them control and compensation of torque. Planes and ships have controlled surfaces, such as rudders, but these are unsatisfactory for the helicopter. Their effectiveness depends entirely upon movement. Hovering motionless in the air is one of the chief desirable features of the helicopter. Furthermore, accuracy of control in the helicopter must be held within one foot, and even within inches.

These problems have been overcome by utilizing two rotors, a large main rotor with blades of variable pitch, semi-automatically controlled, and a rear rotor of smaller dimensions. Control now is so complete and so accurate, that a helicopter can be operated from a space 25 by 25 ft in size, or 35 by 35 ft allowing for safety margin, with no more difficulty than the family automobile is driven into the backyard garage. The

Seven of the nine session chairmen are pictured below. L. to R.: J. M. Shoemaker, Vought-Sikorsky Aircraft Division; R. J. Woods, Bell Aircraft Corp.; A. T. Gregory, Ranger Aircraft Engines, Raymond W. Young, Wright Aeronautical Corp.; Roland Chilton, Wright Aeronautical Corp.; Charles Froesch, Eastern Air Lines, Inc.; and H. D. Hoekstra, Civil Aeronautics Administration. Other chairmen were Fred E. Weick, Engrg. & Research Corp., and Vice-President S. K. Hoffman

SAE Vice-President Samuel K. Hoffman, Lycoming Division, head of the SAE Aircraft-Engine Engineering Activity, who with Vice-President John G. Lee, United Aircraft Corp., was responsible for the SAE National Aeronautic Meeting

Above: William Littlewood, American Airlines, Inc., chairman of the closing session, congratulating Charles Romain Strang, Douglas Aircraft Co., Inc., and presenting him with the certificate of the Wright Brothers Award

Right: SAE Vice-President John G. Lee, in charge of SAE Aircraft Engineering Activity, who with Vice-President Samuel K. Hoffman set up the Aeronautic Meeting program, with Dr. James H. Kimball, eminent meteorologist a few minutes before the closing session

rotor is comparable to a micrometer, with the accuracy of control depending upon varying the pitch of blades moving at a top speed of around 270 mph and consequently giving the helicopter closer control than any ship or plane.

Dr. Sikorsky stated that, in his opinion, the helicopter would supplant neither the airplane nor the automobile, but rather would open to aviation immense possibilities, including safe private use and air transportation for currently inaccessible areas. Listing the limitations of the helicopter, Dr. Sikorsky said its maximum practical speed is 100 to 150 mph, size 12 to 20-passenger capacity. Flying-boat helicopters might be built to accommodate 500 to 1000 passengers.

He described the helicopter as affording short-distance, low-altitude, and slow "pleasure-flying," and as being far less well adapted than airplanes to long-distance flights at high speed.

Giving the increasingly enthusiastic crowd an initial lesson in helicopter operation, Dr. Sikorsky said the controls consisted of directional pedals, for turning to left and right, and two levers. The right lever is pushed ahead if the helicopter is to rise, pulled back when descent is desired. The left lever moves the helicopter in any direction desired within the 360 deg of a circle.

Below: Meeting of the Aircraft-Engine Activity Committee, L. to R are: Carl T. Doman, Aircooled Motors Corp.; A. T. Gregory; R. D. Kelly, United Air Lines Transport Corp.; R. E. Ellis, Standard Oil Development Co.; C. F. Bachle, Continental Aviation & Engrg. Corp.; R. W. Young; and Vice-President S. K. Hoffman

Below: Other members of the same committee. L. to R.: R. N. Du Bois, Packard Motor Car Co.; Miss Ursula Delchamps, sessions secretary; J. D. Redding, staff representative; C. E. Mines, Jacobs Aircraft Engine Co.; N. N. Tilley, Studebaker Corp.; E. S. Taylor, Massachusetts Institute of Technology; and J. M. Miller, Bendix Products Division

Members of the Aircraft Activity Committee in session. Seated, L. to R.: G. W. Brady, Curtiss-Wright Corp., Propeller Division; R. J. Woods; H. D. Hoekstra; R. D. Kelly; SAE Vice-President John G. Lee, chairman, and J. D. Redding. Standing, L. to R.: Harold Harrison, Lockheed Aircraft Corp.; Charles Romain Strang; Dr. N. B. Moore, Curtiss-Wright Corp.; R. G. Bowman, Republic Aviation Corp.; S. K. Hoffman, SAE vice-president; O. E. Kirchner, American Airlines, Inc.; and J. M. Shoemaker, who was chairman of the combined Aircraft and Aircraft-Engine Session

in actual operation the helicopter was said to rise to 12 or 15 ft, then to hover in the air under the influence of "ground effect" as if waiting for the operator to make up his mind. Forward speeds of present models were indicated to be about 65 mph, with speeds backward up to 25, and sideways to 15 mph. Dr. Sikorsky emphasized that no immediate operating decisions are necessary. Unlike the airplane, the helicopter waits upon the operator, a feature which makes flying it unusually pleasant.

Answering questions, Dr. Sikorsky predicted that the helicopter would come into wide use within 10 years after the war, and during the second decade probably would duplicate the "automotive era." He said mass production would bring costs about the level of those of the medium-priced automobile, since many automotive parts, such as truck gears, can be used in helicopter construction. Operating expenses he estimated as being about the same as those of an automobile, with slightly less fuel economy, but practically no tire expense.

He predicted that the helicopter would permit better use to be made of idle or waste land, and suggested that greater use will come first in rural areas. In the vicinity of cities, such helicopter traffic problems as may develop could be controlled by restricting flying altitudes above 1000 ft and establishing air traffic lanes nearer the ground.

Rotors currently are made with three blades, but either two or three are believed to be practical. A single blade, with counterbalance, ultimately may serve the purposes of small machines. The open fuselage currently used was said to be an expedient for better control and later may be revised or eliminated. Dead-stick landings were described as safely possible. Rate of descent is about 1200 fpm, with forward speed of 40 mph. In vertical descents, Dr. Sikorsky said, the ship but not the occupants might sustain some damage.

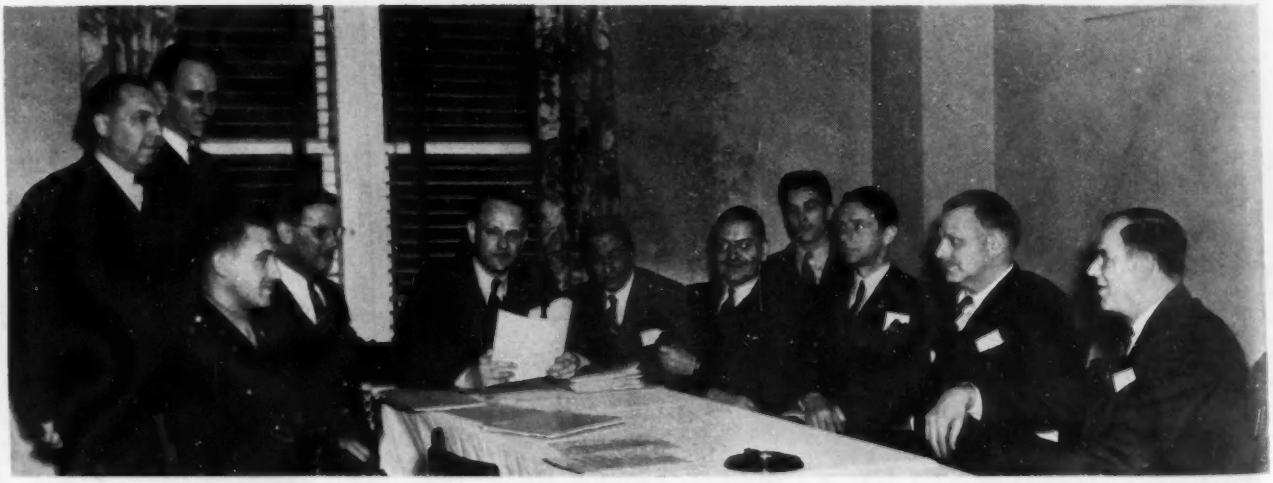
Dr. Sikorsky reported that developments now under way will make changes in the pitch of the rotor blades automatic, yet with the pilot always in control, and may improve lifting power, now ranging from 15 lb per horsepower with the smaller machines to 2 lb per horsepower on the larger. He estimated fuel economy at 7 to 9 mpg.

■

Aircraft

Intensive engineering work on plywoods and their bonding materials was reported at the Thursday morning session on Aircraft, under the chairmanship of F. E. Weick, chief engineer of Engineering & Research Corp., by a representative of the Civil Aeronautics Administration and a manufacturing company engineer. Significant was the amount of new engineering data presented on this old material which has come under the spotlight of war development.

Members of the Aircraft Engine Subdivision of Aeronautical Division of SAE Standard Committee in session: Standing, L. to R.: C. R. Paton, Allison Division; and J. D. Redding. Seated, L. to R.: Capt. H. J. Geder, Working Committee of the Aeronautical Board; E. W. Rentz, SAE staff representative; C. E. Mines; Val Cronstedt, Pratt & Whitney Aircraft; R. W. Young; Eugene Norris, Aeronautical Chamber of Commerce; A. T. Gregory; C. F. Bachle; and C. E. Stryker, Aircraft Production Board



New Techniques Aid Production Of Wood Planes

By IVAR C. PETERSON,
Civil Aeronautics Administration

EFFORTS to mass-produce wood aircraft and to take full advantage of recent developments in glues, fabrication technique, and design have brought us face to face with many new problems and some skeletons of the past.

Wood strength tables fail to give values for tensile strength because of:

Low shear strength of wood, and

The highly critical effect of stress concentrations and slope of grain on tensile strength.

The strength properties of wood are greatly affected by changes in moisture content, and the moisture equilibrium of a piece of wood will vary with relative humidity and temperature to which it is exposed.

In the production of strong glue joints there must be a sufficient spread of glue on smooth wood surfaces, and a correct balance between temperature, pressure, and glue consistency when the pressure is applied.

In sawing lumber the position of growth rings may be made to assume different directions with respect to the surface of the piece. Plywood tension specimens and flexural fatigue specimens having the face-grain direction parallel to the applied load should be notched or tapered very gradually. Plywood tension specimens having the face-grain direction other than parallel or perpendicular to the applied stress should be sufficiently wide to cause the deflection to be constant across the beam at any point in the span length. Block compression tests in which the plywood face-grain direction is other than parallel or perpendicular to the applied stress will not give consistent results unless the specimen width is greater than its height.

The allowable stress for joints which have parallel-grain gluing may be taken equal to the ultimate shear strength parallel to the grain for the weaker species. Static tests frequently give glue shear strengths considerably higher than the shear strength of the wood itself, but even if these strengths were valid it would not permit a reduction in the required joint area. The allowable stress for joints which have cross-grain gluing may be taken equal to one-third the ultimate shear strength parallel to the grain for the weaker species. There is no standard glue-joint shear test by which the allowable value of "one-third the ultimate" for cross-grain gluing can be verified.

The allowable strength and elastic properties of wood and plywood for use in aircraft design have been based on a moisture content of 15%. Because of the effect of change in moisture content upon the strength properties, it is sometimes necessary to correct static test data for wood members having a moisture content other than 15%.

There is considerable controversy at present as to how static-test data should be corrected for the effect of "duration-of-load." Duration-of-load is the time during which the structure fully supports a given maximum load. Wood structures cannot support loads near the ultimate for long periods of time without suffering some loss in strength. The problem arises in the strength testing of complete structures and major assemblies of large airplanes in which loading periods of from 15 to 45 min are necessary to record deflections of the structure at a number of points. At about 85% of the required strength load and higher, every effort should be made to reduce the length of time that the structure must support the full load. At 100% of the required strength load, the structure should not be expected freely to support the entire load for more than about half a minute. Design of metal shear webs in the tension-field range is not advisable for an efficient design of plywood webs.

In the case of the box-beams, any buckles which form under load become deeper as the load is increased and these tend to pull the web away from the flange. In the case of the I-beam, there is no opportunity for the web buckles to project on through the web-flange attachment. In designing reinforced plywood compression panels, it is necessary to determine what stiffener width is required to provide sufficient glue area to prevent separation of the plywood and stiffener under load. There is a tendency for wood to split and shear-out in front of the load in bolted joints for solid wood members under tension loadings. One of the most common recommendations for good detail-design practice in wood-aircraft construction is to use plywood bearing plates for all bolted connections.

It is possible to use high- and low-density woods in combination with highly stressed members satisfactorily, but the differences in elastic properties are a potential source of trouble. Particularly in wings premature failures in static tests have sometimes been caused by the elastic incompatibility of high- and low-density woods.

The proportional limit of wood in tension is very near its ultimate strength. This, combined with the weakness of wood in shear and cleavage makes it *essential* that abrupt changes in section, re-entrant cuts, odd-shaped lightening holes, and the like be avoided wherever possible.

(Digest of "Problems in Wood Aircraft.")

DISCUSSION

Heating by radio frequency, explained Mr. Peterson in answer to a question, has received considerable notoriety recently—probably more than it should have. Wood aircraft manufacturers have been running out to buy high frequency heating equipment, and there happens to be a serious shortage of materials which go into the making of this equipment.

W. A. Bennett, East-West Consultants, said cold-pressed glues should set around 75 to 85 F with high frequency heat. Setting temperatures above 150 F should not be used with cold-pressed glues because steam tends to form in the wood, completely collapsing the wood cells. Two hundred deg applied for a considerable length of time will destroy strength of the glue.

Herb Packer, *Aviation Service Magazine*, questioned the square gusset in one of the

turn to page 25

Members of the Ignition Research Committee, which met April 8 during the SAE National Aeronautic Meeting. Seated, L. to R.: A. L. Beall, Wright Aeronautical Board, chairman; R. L. McBrien, United Air Lines Transport Corp.; Hector Rabezzana, General Motors Corp.; W. S. Mount, Socony Vacuum Oil Co.; and A. G. Haskell, Champion Spark Plug Co. Standing, L. to R.: J. S. Coldwell, Globe Union, Inc.; H. K. Cummings, National Bureau of Standards; D. J. Lowman, Wright Aeronautical Corp.; R. W. Brown, Firestone Tire & Rubber Co.; F. H. Highley, Firestone Rubber & Metal Products Co.; and George M. Paulson, B. G. Corp. E. K. Von Mertens, not in this picture, attended this meeting

News..

..OF THE SOCIETY

ODT Maintenance Program Urges Conservation Study

▪ Southern California

"THE ODT has obtained good results from the transportation conservation program principally because every operator has done his part," declared Roy Long, district manager of the Office of Defense Transportation, at the April 2 meeting of the Southern California Section. The second speaker of the evening, H. E. Jordan, superintendent of equipment of the Los Angeles Railway, who is chairman of the ODT Maintenance Advisory Committee, told of the problems confronting the committee and reported two plans which they hope will clear up the situation.

"During the latter part of 1941 surveys showed that only one-third of one per cent of available truck days were lost due to lack of parts," Mr. Long went on to explain, "and during the latter part of 1942 we lost 2.4% of possible working days for the same reason.

"We took these alarming figures to Washington, with the result that the Office of Defense Transportation was appointed claimant agency before the War Production Board for the securing of necessary materials that are used in the manufacture of parts. This gave us the privilege of appearing with other claimant agencies, such as the War and Navy Departments, to present the case of the truck operators. However, before our claims can be accepted as comparable with those of the War and Navy Departments, we must prove that wasted transportation has been eliminated from the highways."

Mr. Long reported that a Maintenance Advisory Committee to the ODT was organized a few weeks ago to keep the ODT informed on maintenance.

Maintenance Advisory Committee Chairman H. E. Jordan outlined the transportation problem as follows: (1) no availability of parts, and (2) loss of men to the armed services. "These two things," he said, "are putting us a little close to the end of the rope. Unless some relief comes soon, we will collapse.

"We have two plans in mind that we hope will help clear up the situation. First, all manufacturers agents are to give us monthly reports on all back orders. All operators must send in lists of jobbers and agents with whom they deal to be checked. Second, emergency information sheets are to be made out covering any vehicles that are to be laid up within 21 days, and these sheets will be known as ODT Emergency Air Orders. The operator is to give full description of work being done, the vehicle, repair parts needed, and so forth. This is sent to the ODT, and if they determine it sufficiently essential, a rating will be given so that necessary parts can be obtained."

Major W. H. Jaynes of the Santa Anita Training Center, said: "Get us the tools, get us the equipment, get us the buildings, and we will be able to do a real job. We know that the expansion program is very great, and therein lies most of our difficulties. At present we are sending out 600 fully-trained men per week, and their training period covers 13 weeks. Because of lack of tools, training is carried on in three shifts covering the 24-hour period. We feel that preventive maintenance as practiced in the Army – before, after, and between times – will keep 'em rolling."

"Preventive Maintenance as a Usable Tool," was presented to the audience by Wallace Linville, chief automotive engineer of the General Petroleum Corp., in a rather unique way.

A display table in the lobby contained many defective automotive parts. A questionnaire was given each one to fill out after examining the parts. When the questionnaires were completed Mr. Linville gave explanations and correct answers to the nine questions – and no one bragged about a 100% rating.

Mr. Linville stated that preventive maintenance is only a tool, and it is up to us to use our own ingenuity to do the job.

H. E. Jordan

Roy Long

Discusses Experiences of Small but Effective 'Jeep'

▪ Canadian

Problems of spring suspension on tanks were discussed by Henry Fuchs, General Motors Corp., at the Canadian Section meeting of March 17. He outlined the problems and current developments in suspension for this fighting equipment to permit the vehicles to get the most efficiency from their powerplant output, and to improve maneuverability.

Describing the manufacturing operations

SAE JOURNAL FIELD EDITORS

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Northwest – Lee Ketchum
Oregon – Dick F. Wagner
Philadelphia – John G. Moxey, Jr.
Pittsburgh – Murray Fahnestock
St. Louis – No appointment
So. California – L. L. Benbow
So. New England – J. A. Clark
So. Ohio – L. Parmakian
Syracuse – No appointment
Washington – Paul B. Lum
Wichita – Mitchell Zurawinski

of the jeep, Donald Stone, Willys-Overland research engineer, explained the methods of achieving the greatest possible ruggedness with the performance requirement of this small, effective military vehicle. He detailed some of the combat experiences of this 4x4 unit, development of which has been accredited to the Willys company by military spokesmen. For many years a factor in the engine and chassis test work of the company, Mr. Stone explained the similarities and dissimilarities of the fundamental and detailed design problems.

Conservation of Alloys Recommended in Report

The SAE War Engineering Board Ordnance Progress Report No. 9 of a series on "Conservation of Materials in Army Ordnance Standards" has recently been issued by the Iron and Steel Committee, Chairman W. P. Eddy, Jr., announced.

These recommendations give first and second choices of steel for 68 different parts, consisting mainly of nuts and bolts. The suggestions are made on the basis of calling for materials having the least amount of critical alloys that are believed capable of providing satisfactory service. The report covers 70 pages of parts containing critical materials. All recommendations are definite and none require testing.

The report was drawn up by a subcommittee consisting of E. H. Stillwill, chairman, Chrysler Corp.; W. P. Eddy, Jr., Yellow Truck and Coach Mfg. Co.; and W. H. Graves, Packard Motor Car Co.

Antifreeze Study Made For QMC

Completed recently by the SAE War Engineering Board Antifreeze Committee was a progress report for the Office of the Quartermaster General entitled "Inhibitors for Used Ethylene Glycol Solutions."

This report, issued Dec. 10, 1942, gives

Cold Operations

Hundreds of miles north of the United States-Canadian border, where the temperature often falls 50 deg below zero, is Camp Shilo, officially known as the Winter Proving Ground. The men here are engaged in tests and experiments which will assure the American soldier and his allies the best of fighting tools. Front row, left to right: E. J. Althouse, Perfection Stove Co., Ted Roehner, Socony-Vacuum Oil Co., Wally Childs, Evans Products Co., Jack Little, Chevrolet Motor Car Co., R. L. Weider, The White Motor Co., W. R. Westphal, International Harvester Co., Inc., Frank Kalbe, Ford Motor Co., Van Brunt, Westinghouse Electric & Mfg. Co., Jack Cross, Hercules Motors Corp., Ben Franklin, General Motors Truck & Coach Division, Ed. Sintz, Cadillac Motor Car Division, Col. George G. Eddy, Ordnance Department, Col. Schomberg, Commanding Officer. Second row, left to right: Dan Davis, Studebaker Corp., Al Bach, International Harvester Co., Inc., Louis Fieronzi, Esso Oil, H. M. McPhilliamy, General Motors Truck & Coach Division, Major Childs, Ordnance Department, Dick Besserdick, Allis-Chalmers Mfg. Co., John Kalb, The Texas Co., John Kraemer, Sperry Gyroscope Co., Inc., Nelson Farley, Willys-Overland Motors, Inc., A. C. Fay, Chrysler Corp., Bob Snyder, B. F. Goodrich Co., Fred Cowan, Cadillac Motor Car Division, Ralph Strohl, Autocar Co., C. B. Mulleague, Caterpillar Tractor Co. INSET: R. L. Weider, development engineer of the White Motor Co., chairman, Camp Subcommittee of the SAE War Engineering Board Operations Committee

WEDNESDAY, MAY 5

MORNING

D. K. Wilson, Chairman

EXPERIENCE WITH WOMEN DRIVERS

Heavy-Duty Truck
– M. A. Savin, Savin Express Co.

Delivery Truck
– Robert Gayley, Supplee-Wills-Jones Milk Co.

AFTERNOON

Austin M. Wolf, Chairman

Field Modification of Ordnance Vehicles
– Lt.-Col. Harry O. Mathews

DINNER

Wednesday 7:00 p.m.

Speaker: **Brig.-Gen. Julian S. Hatcher, Chief of Field Service Division, Office of Chief of Ordnance**
Subject: ***"Ordnance Field Service – The Connecting Link between Producer and Soldier"***

Toastmaster: Austin M. Wolf
Greeting by Herbert Happersberg

THURSDAY, MAY 6

MORNING

E. P. Gohn, Chairman

PARTS RECLAMATION

Cold Welding
– A. B. Tincher, Kerkling & Co.

Fleet Experience with Metal Spray
– H. I. Sullivan, Eastern Massachusetts Street Railway Co.

AFTERNOON

S. G. Page, Chairman

PARTS OUTLOOK

Wartime Replacement Parts
– Robert M. Cass, White Motor Co.

■ ■

Hotel Pennsylvania · New York
May 5-6
★

information regarding various materials that may be added as corrosion inhibitors to used ethylene glycol antifreeze solutions drained from radiators for re-use.

Most of the companies cooperating in the preparation of this report had not accumulated sufficient data by the time it was issued to make detailed recommendations. Two, however, did make specific suggestions. One of these advised using 1¼ oz of a mixture of 96% borax and 4% mercaptobenzothiazole per gal of antifreeze; and the other suggested morpholine as an inhibitor. It is expected that a more complete report will be made available when more data have been assembled.

The subcommittee responsible for this report included representatives from both the automotive and the chemical industries, and was headed by E. H. Smith, as W.E.B. sponsor, and W. H. Graves, chairman, both of the Packard Motor Car Co

Develop Packing Technique For War Shipping, Storage

The five subcommittees of a War Engineering Board committee that have been studying the broad subject of preparation and preservation of engines, vehicles and spare parts for storage and for export shipment have just completed their first progress reports to the Ordnance Department. (See "Accelerate Study of Protective Packing," p. 23, *SAE Journal*, April, 1943.)

In this 128-page report the 77 committee members and consultants drawn from many industries have presented recommendations which it is believed will fully protect every piece of automotive equipment against corrosion and other forms of deterioration from the minute they are manufactured until they are ready to go into action in the far-flung combat zones of this global conflict.

W.E.B. Subgroup Completes Ordnance Spring Manual

A comprehensive manual on design and application of helical and spiral springs for ordnance is a recent contribution by an SAE War Engineering Board subcommittee to the Army Ordnance Department. Circulation of the new manual will be on a restricted basis.

Compiled as a guide for the designer of ordnance springs, the new manual details the characteristics of available spring materials and the design characteristics peculiar to ordnance springs.

Ordnance spring requirements, the manual emphasizes, contrast sharply with peacetime spring applications where maximum possible endurance life frequently is the only important requirement, permitting ample material and low stresses. Features peculiar to ordnance springs, it stresses, include necessity for (1) lowest weight and smallest space; (2) minimum chance of failure during a very limited life expectancy; and (3) absolute reliability under extremes of temperature, atmospheric and corrosive conditions. The 37 pages of detailed data in this W.E.B. manual were developed on the basis of full recognition of these special requirements.

Headed by Tore Franzen, Chrysler Corp., as chairman, the 31-man W.E.B. Spring Committee which produced the manual had

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figures in Mr. Peterson's paper. Mr. Peterson believes that a square or trapezoidal gusset is stronger, and 50-50 construction should always be used in plywood gussets. In order to obtain the maximum strength in the direction required, the plywood face grain directions should be located. In any case, the 50-50 construction and not 33-67 construction should be used.

The question of why glued pieces cannot be moved in assembly was asked by Dr. Robert J. Nebesar, Universal Moulded Products Corp. The moving of assembly right after nailing strips have been put on, answered Mr. Peterson, would be very undesirable, and he believes that the Army, Navy, or CAA would be against it. Dr. Nebesar suggested that if the assembly is rigid enough nothing would be disturbed. Making parts fit is the main point where nailing strips are concerned. If the surfaces are not brought into exact contact, he declared, you don't get enough pressure in the glue joint even if all the pressure in the world is applied.

Morley Lazier of the Massey-Harris Co., Toronto, believes nail strips are impractical because of: (1) labor of putting them on; (2) labor of taking them off, and (3) loss of structural strength. Tests for determining strength of nailing are a waste of labor, and nailing should be eliminated.

Mr. Bennett disagreed with Mr. Lazier on the elimination of nailing because this would seem to imply that nailing strips are very seldom used, whereas about 60 or 70% or an even greater number of wood aircraft manufacturers are still using nailing strips.

John G. Lee of United Aircraft Corp. suggested that perhaps a cloth strip of some kind might be used successfully. Because of variations in wood, Mr. Bennett said, it is practically impossible to get a perfect line unless some resilient material is used in the joint.

Whenever the temperature in a glue job can be brought up from room temperature, you get a much better job in a much shorter time, declared Ralph Casselman of the Bakelite Corp.

In final assembly of thick plywood sections, there must be a definitely good bind and pressure, and therefore the sections must be in intimate contact, said G. B. Parsons, Duramold Corp. He feels that high frequency gluing is not out of reach. However, in final assembly with high frequency gluing, good pressure must be obtained as nailing is necessarily out since the area around nails will burn if this method is used. His company has found that when they use infra-red, after the heat is taken away the wood on the outside seems to swell. On the question of box or bar beams, Mr. Parsons agrees with Mr. Peterson that I-beams are best because of: (1) sheer connection, and (2) there is difficulty in protecting the interior of a box-beam from deterioration.

Rigidity of Framing Should Be Equivalent To That of Uncut Panel

By L. J. MARHOEFER,
Vidal Research Corp.

AN annoying but necessary evil in all monocoque aircraft structures is providing doors, windows, access holes, and wheel-well cutouts. These seem always to occur at locations where the moments and shears are approaching maximum values, and leave a nerve-wracking gap in the structural investigation. In lieu of adequate methods of examining stresses in the vicinity of openings, accepted practice is to install framing of sufficient size to provide rigidity equivalent to an uncut panel.

Where materials of low ductility – such as molded plywood – are used, more care must be exercised in providing reinforcing around holes. Due to low ductility, the failure of a small portion of a monocoque shell can result in major failures where only secondary portions of the structure were under strength.

Ring Reinforcements Used

For hand holes around control pulleys and hinge brackets through shells carrying low stresses, a ring four to five times the skin thickness in depth provides satisfactory reinforcement. The ring width is usually governed by space requirements for cover attachment. Rings should be made of bent wood or laminations with grains running circumferentially. Flat, cross-laminated pads are often used, but their strength is much less satisfactory due to unfavorable grain angle necessitated in cutting a ring from flat plywood.

Where handholes are required through portions of the wing, care must be used to prevent piercing the flange material. In laminated and molded structures the weakening effect of flange discontinuities is not accounted for by the omission of cutouts from section property calculations. Openings through structural portions of a wing should be put on the first layout of the wing to ensure that no flange material is interrupted by the cutout. Providing sufficient strength around openings in structural parts may be summarized as the provision of clearly defined force and shear flow paths around the opening. Each individual plane presents peculiar problems, and will defeat any but the broadest rules.

Observation during the tests of fuselage, approximating the size of a 10-place transport airplane, was facilitated by the rather large shear panels which buckled under shear loads, and permitted simple visual determination of the panels carrying the shears as well as those which were shirking.

The most interesting portion of these tests occurred during application of the maximum horizontal tail surface loads while the fuselage was anchored at the wing attachment. Shear wrinkling of the fuselage panels on the side opposite the door occurred at 70 to 80% load, while the panels immediately forward and aft of the door remained unwrinkled. Loading was progressively increased. Diagonal compression struts were installed in the panels on the left side of the fuselage to relieve a portion of the load when the depth of the wrinkles became alarmingly severe.

The side with the door cut out, however, showed no buckling tendency until 110% load was applied and then the buckling was not pronounced. These wrinkles provided good delineation of the natural shear paths around the door opening. The shear in the door side adjacent to the door openings transferred through the fuselage frames to the opposite side, due to the greater rigidity of this path compared to the direct path through the door frame.

Tracing the shear path further by the wrinkling, the first bay forward of the opening was only lightly loaded. Forward of this bay the frames again transferred the proper shear into the door side. One obvious correction of this wandering shear would consist in stiffening the door framing to provide the required rigidity to equalize the shear forces on both sides of the fuselage.

The distribution of shear forces through the two sides is redundant, due to the variable skin thickness. Mere changing of skin thickness will not shift the shear path as much as the shifting of the flange material.

Openings in a monocoque shell will have an effect somewhat analogous to a shell thinned on one side. Adequate design in the vicinity of such openings should not only incorporate adequate framing in the skin, but transverse fuselage frames in the vicinity should be of sufficient rigidity to transmit some of the shear to the opposite side. As a further precaution it is well to assume that the unopened side of the shell will be loaded more heavily than simple calculations indicate.

(Digest of "Effect of Openings in Molded Plywood Structures.")

There was no discussion of Mr. Marhoefer's paper.

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Aircraft Engine

Practical correlation of work of engineers with entirely different technical backgrounds is under way throughout the nation to solve the problems of putting aircraft engines on the mass production lines. Chairman A. T. Gregory, chief engineer of Ranger Aircraft Engines, introduced engineers of two automobile companies now in the aircraft engine manufacturing business at the first Aircraft-Engine Session of the meeting.

Mock-Up Speeded Chevrolet Engine Test Cell Project

By P. A. COLLINS,
Chevrolet Motor Division, General Motors Corp.

PROVIDING aircraft-engine testing facilities for the Pratt & Whitney engines to be built by Chevrolet proved no mean task; but the job has been accomplished, and with dispatch.

The first problem solved was which type of test to use – propeller-type stands or power recovery. Difficulty in obtaining power recovery equipment led to the use of propeller-type stands. It was further decided to use the Pratt & Whitney type of test cell and engine mounting design.

To save time and materials and to help in determining equipment installation, a mock-up of a production test cell was built. From it the engineers were able to determine final design of the wiring harness, gas lines, oil lines, pressure lines, hose, and so forth. It was possible to purchase these parts fabricated, ready for installation, because all production cells were identical.

The cells are the conventional 16-ft "U" type, 80-ft long, with vertical exhaust and intake stacks. Control rooms are air-conditioned and the carburetor air is filtered.

Chilled Water System

Insufficient water supply to handle carburetor and oil cooling led to design of a chilled water system that furnishes water to the heat exchangers at the proper temperature, the same water being recirculated through the refrigerating machines.

For the experimental department, plans were made for a 20-ft flight test house, two 2800 hp dynamometers, a single-cylinder dynamometer, a carburetor flow room, and many other details to comprise the engineering test facilities.

Another problem was training personnel. This was done by sending men to Pratt & Whitney plants for two to six months. They were given opportunity to study the Pratt & Whitney production methods and quality; were even placed in production test cell and dynamometer operation with Pratt & Whitney operators. These men were the nucleus for starting the production test cells in operation. They became supervisors or were put on experimental testing.

New test operators are put to work immediately in the test department under guidance of an experienced leader. For two weeks the learner is taught to remove and replace such parts as spark plugs and fittings, and to mount and dismount engines. The next two weeks are spent in the classroom, learning the fundamentals of engineering required in testing. He begins to get acquainted with control equipment and instrumentation, mounted on a control desk in the classroom.

The size of the original plant has since been doubled to take care of tripled production contracts, showing that real gains have been made in increasing plant efficiency. This has been accomplished in part by progress in production quality, reduction in the number of penalty runs, reduction in hours on preliminary test time, a decrease in engine mount and dismount time.

(Digest of "Chevrolet's Aviation-Engine Test Plant — Its Organization, Development, and Operation.")

Youth of America Has 'Basic' Training For Engine Testing

By L. R. GRANDY,
Buick Motor Division, General Motors Corp.

YOUNG men and women by the hundreds have successfully replaced specially trained engineers in aircraft engine testing, to the surprise of seasoned automotive engineering executives who were saddled with the responsibility of giving huge engines their test runs from accelerated mass production assembly lines.

Before Buick's Melrose Park aircraft engine plant was completed and while manufacturing equipment was being built, arrangements were made with a technical school to train 200 young men as engine testers. But as soon as they had a few months of experience back of them, the Army and Navy began taking them faster than new men could be put through the 10-week specialized testing course.

The only way to get testers was from run-of-the-mine applicants at the company's employment office, and these men and women were trained by the few remaining experienced men to:

Operate a slide rule,
Print legibly on the log sheets, and
Be watchful and alert.

If their eyes were good enough to read the instruments on the panel, they became engine testers.

True graduates of the homes, playgrounds, schools, and even the streets of the United States, these men and women have displayed remarkable alertness and upon their own initiative have prevented disastrous fires and explosions, and damage to high-cost engines.

The "power recovery system" of testing was decided upon, although it involved numerous engineering headaches to harness the power for re-use. A tested engine can be removed and another installed in less than 12 min.

Every effort was made to make the test cells safe. The walls are of 12-in. concrete, with double sound-proof doors. Sound-absorbing material was used in the passages of both cooling and exhaust fans, and as a liner for each control room. A two-section safety glass window is provided to keep the sound levels low, and permit the operator to see into the cell. Control rooms are all air conditioned.

The carbon dioxide fire extinguishing equipment is both automatically controlled and manually operated.

Exhaust fans in each cell displace air at a rate slower than cooling air is blown in, causing a slight pressure depression so that should a leak occur, carbon monoxide would not escape. An added precaution is the use of aqua flow system for gasoline and lubricating oils.

Every known safety precaution, such as usual and special switches and circuit breakers on the electrical equipment have been installed. A poppet type explosion valve was designed and built into the fuel supply system, and remote controls were developed to act in case the test operator forgot to open or close valves.

(Digest of "Training Operators for Aviation Engine Testing.")

DISCUSSION

(Papers by Messrs. Collins and Grandy)

Maintaining test equipment accuracy to ensure testing within safe operating limits – particularly during the final test and with inexperienced operators – was stressed by Donald J. Lowman, Wright Aeronautical Corp., in his prepared discussion. He also discussed the greater flexibility of the propeller test stand as compared with the power recovery system, if there should be a demand for a larger engine or lower reduction gear ratio, which would render the present model obsolete. "We have found," he said, "that even with the flexibility rendered by test propellers, it is difficult to keep our test equipment ahead of production needs."

Air measuring equipment on production stands, provided it can be maintained accurately within experimental error, was also mentioned by Mr. Lowman as useful in maintaining standardized performance and in shooting trouble. "We have chosen the rounded orifice method because of the ease of checking for accuracy rather than from ease of operation," he said. "Some time ago, our accuracy was questioned, and orifices from the Wright and Pratt & Whitney were checked at NACA against a standard Westinghouse VDI orifice and reported within ±1½% over the operating range. Imperfect or damaged orifices are eliminated by an inspection system in accordance with the A.S.M.E. Power Test Codes."

Mr. Lowman suggested that the time required to install the equipment to test the engine (such as engine mount, starter, and the exhaust stacks), and the time used to remove this equipment, together with inspection time and handling to the installation area, should be added to the time required for mounting an engine, to obtain an overall picture of the operation.

Details on Cells

Details on the cells used at Ranger were disclosed by Chairman Gregory. General specifications include: "U" propeller test type, 42-ft long, 12-ft square throat, and 12-in. reinforced concrete construction. The cells are equipped with wooden doors sliding up into the stack to close off the cell in cold weather.

Carburetor air is drawn in through smooth-approach orifices from the control room, using the control room air conditioning unit for temperature control. Oil and fuel systems are conventional, using scales to measure flow in both cases. Test stands are of the rigid type. All engine connections, with the exception of main oil lines, are made with quick-connect couplings. A complete 12-cyl engine change can be made in an hour, and a 6-cyl engine change can be done in 30 min.

All new test house employees with no previous experience, Mr. Gregory said, are put through a 160-hr training course, half of this time being spent in the classroom learning elementary engine theory, how to use the slide rule, and test procedure, and the other half is spent in the test house.

Women operators are being used at Ranger. In production, they operate 6-cyl engines on test and act as observers for 12-cyl engine testers. In experimental work, women also operate the carburetor air box and the supercharger laboratories in addition to engine operation.

Mr. Grandy expects an increase in the number of women operators, as in general they do very well, needing only slightly more training time than men. Women are satisfactory as operators, he said, as they need not do any heavy work. In addition to operating the engine, they clean the obser-

vation window and take down the engine data.

Answering several questions about the coupling used on test equipment, the author explained that the coupling between the engine and the dynamometer was an electric coupling with an eddy-current dynamometer, excited by d-c. An automatic speed control holds the speed at 1600 rpm to within ±5 rpm. A mechanical coupling is used between the engine and the electric coupling.

Power recovery is obtained about two-thirds of the time, Mr. Grandy claimed. The best month at Melrose Park in this respect was when 69% of all power used was recovered. Power recovery starts when engine speed reaches 1600 rpm.

S. K. Hoffman, Lycoming Division, Aviation Corp., and B. W. Geddes, Standard Oil Development Co., questioned the use of the 65 octane fuel. Mr. Collins said it was used only to run out the engine to get it clean and free from lead, and is not used for tests.

Backfires occur in about one out of every three or four engines started, but the automatic poppet explosion valve prevents harm, Mr. Grandy said, in response to a question by R. N. Du Bois, Packard Motor Car Co.

In reply to another question about the test instruments by O. G. Lewis, Standard Oil Development Co., both authors said that all essential pressures are measured with manometers and temperatures on potentiometers. The other instruments that must be watched by the operator are for safety. Mr. Grandy also told about a portable stand that is used at Buick to check instrument accuracy. This portable stand is not used to check the accuracy of the rotameters, which are taken to the repair room for checking, he said in answer to a question by E. S. Titus, Ranger Aircraft Engines.

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Aircraft

A year ago, the problem of protecting pilots against the hazards of birds crashing through windshields was presented before an SAE audience. This year, suggested solutions were presented by an engineer of the CAA, which undertook the most practical testing project ever attempted, and an engineer of an airline whose work closely matched the CAA findings. Charles Froesch, chief engineer of American Airlines, Inc., served as chairman of this Aircraft Session.

Bird-Resisting Windshield Studies by CAA Disclose Progress in Plane Safety

By A. L. MORSE,
Civil Aeronautics Administration

WHEN the subject of swans versus airplanes was reported upon to SAE a year ago, suggestions for resisting such impacts existed only on paper. The prospect appears much brighter since development of bird-proof windshields was undertaken by the Technical Development Division of the Civil Aeronautics Administration last July.

De-icing must be considered with the problem of bird protection, because the constructional details involved are interdependent. Most effective of several de-icing methods is by hot-air circulation. Therefore, the CAA experimental windshields consist of two panels separated by a narrow air space. Thermal de-icing also is important, since the high temperatures of plastic interlayers of the windshields are necessary to maintain adequate resistance to impact.

Projection of a 16-lb carcass simulates collision with a 20-lb swan, the wings of which extend beyond the windshield frame, and for present-day carrier-type aircraft, impact velocities up to 270 mph are considered likely. Facilities for tests include a compressed air catapult or gun which is capable of tossing bird carcasses weighing 17 lb at velocities up to 400 mph.

Immediate need for protecting the most widely used present-day carrier type airplane – the DC-3 – influenced this phase of the program. First consideration was panel dimensions. It was felt that warm-air de-icing had proved sufficiently effective to permit single panels extending from the center post to the corner stanchions, eliminating the intermediate posts and sliding panels. Examination of the DC-3 structure confirmed the practicability.

"Safety Glass" Tested

Protection provided by the conventional "safety glass" windshield of the DC-3, supported in the conventional manner by clamping frames, was tested. These panels – ¼-in. thick, including a 0.015 in. interlayer of vinyl plastic – when tested both in the target and in the DC-3 structure, were penetrated by a 4-lb carcass at 75 mph. This explains why so many collisions with birds have shattered windshields and injured pilots.

Similar panels, but having ⅛-in. semi-tempered glass faces and a ⅛-in. interlayer of vinyl plastic, were tested the same way. They were pulled out of the frames by 4-lb birds traveling at 90 mph, but were not penetrated, thus indicating need for a more secure mounting. It was decided that the plastic interlayer should extend beyond the edges of the glass and around the entire periphery to provide means for bolting the panels to the supporting structures; also that the de-icing panels should be mounted ahead of the impact-resisting panels to determine effectiveness of the combination.

Tests showed that the laminated glass-vinyl construction with extended plastic edges provides greatest impact resistance. Panels with ⅛-in. vinyl interlayers of 20% plasticizer content were found to resist the impact of a 4-lb carcass at velocities approximating 300 mph, but were penetrated by 15-lb carcasses at velocities as low as 125 mph.

Panels with ⅜-in. vinyl interlayers were found to resist the impact of a 150-lb carcass at a velocity of approximately 200 mph. With a ½-in. vinyl thickness, however, the impact strength was only slightly improved. Panels of all-plastic construction and weighing approximately the same as the ½-in. vinyl-glass combination were penetrated by 15-lb carcasses at approximately 130 mph.

Penetration velocity of vinyl plastic of 20% plasticizer content is increased approximately 30% as the temperature is raised from 75 to 115 F. Penetration velocity of vinyl plastic of 30% plasticizer content is decreased as the temperature is varied from 75 to 115 F.

Tests conducted so far mainly have involved investigations of the effect of various types of panel construction and mounting, and the effect of other pertinent variables. No attempt has been made to combine the more promising features in a single windshield.

They have indicated, however, that the glass-vinyl type laminated windshield, with extended plastic edges bolted into an adequately reinforced windshield frame, provides practically 100% protection for the DC-3 against collision with birds weighing up to 4 lb, and that a high degree of protection practically may be provided against collisions with larger birds up to 20 lb.

Such protection is possible for all anticipated impact conditions and for all ambient temperatures encountered. The net increase in weight would be approximately 15 lb. Optical characteristics are believed acceptable.

Provisions have been made for continuing this program.

(Digest of "New Windshield Developments.")

DISCUSSION

H. E. Hoben, American Airlines project engineer, described the test work done by his company on shock resistance of laminated glass. The first step was to examine accumulated damaged windshields, which suggested several design changes.

A 6-in. drop of a 25-lb bag of shot, slightly padded on the bottom, shattered the windshield formerly used. This led to strengthening the laminated glass, which now withstands a 12-ft drop. None of the windshields have been broken in flight since, although some of the 30 transport planes have been so equipped for two years. The weight increase for this added protection is about 5 lb.

Lt.-Col. E. M. Gavin, AAF, said that the Army is particularly interested in all new de-icing developments.

Double Windshield, With Hot Air Space, Reduces Ice Forming

By R. L. McBRIEN,
United Air Lines Transport Corp.

DOUBLE windshields for airplanes, with heated air circulated through the inter-pane space, is the most satisfactory method known of preventing frosting. This development by United Air Lines followed careful study of numerous methods proposed and developed to eliminate windshield ice. The idea was first proposed by the National Advisory Committee for Aeronautics.

Hot air comes either from the airplane's heating system or from small internal combustion heaters. Success, however, depends upon the manner in which heat is extracted from the air by the windshield.

For the test set-up, the outside pane was ¼ in. High-Test safety plate glass. The inside pane was of ⅛ in. safety glass. The inter-pane space was ¼ in. Intake and exhaust headers were at the left and right edges of the dual installation, respectively. A spray of water was used to ice the outer surface of the outer pane.

Because of the added weight of fans or blowers, static pressures of the outside air at several locations were studied to determine the point of exhaust. A point in the skin where there was a 10-in. water pressure drop at cruise speed was chosen. At 19 deg

F, the lowest temperature of the test, ice formation was prevented.

Use of a small internal-combustion heater prevented icing at a lower rate of air circulation because the air was of higher temperature.

With some changes, this type of windshield was installed by the company for scheduled operations. But not without troubles. Panes cracked due to thermal and mechanical strains, particularly the inner ones. Plastic inner panes were tried, but tended to deflect and restrict the hot air flow when the plane entered a low pressure area. Plastic panes have poorer optical qualities, but the most objectional feature of plastic panes is that the surface generates static electricity – becoming an electrostatic dust-separator and impairing forward vision.

The present dual pane consists of an outside pane of ¼-in fully-tempered plate glass, and an inner pane of ⅜-in. laminated plate composed of two ⅛-in. semi-tempered plate and a ⅛-in. plastic inter-layer. Despite the relatively poor optical qualities of the laminated pane, this has proved satisfactory. The solid outer pane is more effective in preventing icing because it transmits heat better than would laminated glass.

However, experience has proved that flight officers frequently do not turn on the heat until ice actually starts to form. The captain's face is normally from 10 to 12 in. from the inner pane, and the heat is excessive. This dual installation is effective in resisting bird strikes.

(Digest of "An Aircraft Double Windshield – Its Development and Use.")

DISCUSSION

Otto E. Kirchner, chief engineer, American Airlines, discussed the use of a removable shield inside the windshield. This device is quickly removable by the pilot when not needed and when optical requirements are most critical, such as in landing. Icing, he pointed out, was not a constant problem with domestic airline operation.

Several engineers questioned Mr. McBrien about non-reflecting treatment of windshields. He replied that the airlines must await commercial development of a treatment now used on small areas, such as camera lenses. He also added that he was surprised to find that only a small amount of heat was needed in the dual windshield assembly to prevent de-icing.

W. J. O'Connor described a method of heating a dual assembly by a transparent liquid, which was heated to the proper temperature and pumped through the unit. Upon questioning by A. L. Morse, who feared the use of a hot liquid should a bird or other object penetrate the windshield, Mr. O'Connor pointed out that the temperature of the fluid was about 100 deg F, and would not burn the pilot's face.

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Aircraft Engine

Consensus of scores of veteran engineers was that Chairman Roland Chilton's Aircraft-Engine Session was at once one of the most revolutionary and practical discussions in metallurgical engineering literature to date. The speaker, a research engineer with a rich experience in the automotive industry, reviewed some fundamentals that shocked his audience into a prolonged discussion of practical problems.

Probe Failures By Fatigue to Unmask Mechanical Causes

By J. O. ALMEN,
Research Laboratories Division,
General Motors Corp.

IT IS DOUBTFUL whether we are getting more net work from metals today in dynamically loaded parts than was obtainable 25 years ago. Speed and performance of airplanes have increased because of better power-weight ratio of engines. Aerodynamic improvements in propellers and airplane structures, and new fabrication techniques, have made possible many design improvements. But the basic useful strength of our structural materials remains unaltered.

Although no super-strength alloy discoveries seem imminent, much can be done to increase the fatigue strength of many machine parts made from ordinary structural materials by merely extending processes that have long and honorable histories, and avoiding practices that reduce fatigue strength.

We have today new concepts of fatigue failure:

Fatigue failures result only from tension stresses, never from compressive stresses, and

Any surface, no matter how smoothly finished, is a stress raiser.

Fatigue Vulnerability

Surfaces of repeatedly stressed specimens, no matter how perfectly finished, are far more vulnerable to fatigue than the deeper layers. Evidence of this is strong. Sub-surface fatigue failures, usually called fissures and attributed to faulty material, have long been known to occur in railroad rail in which the surface is stressed in compression by the cold work of heavily loaded locomotive and car wheels. Surface compression to improve the strength of steel has probably been discovered, forgotten and rediscovered many times. Certainly every blacksmith knew and practiced the art. However, strength of machine parts has been decreased by too intense surface peening.

Residual stresses due to quenching from relatively low temperatures may reach considerable magnitudes and may be harmful or helpful to fatigue durability depending upon whether the trapped stresses augment or diminish the tension stresses from the applied loads.

Internal stresses of the wrong kind are perhaps most insidious of all fatigue hazards because we can seldom know their magnitude or pattern of distribution within the material, or whether they are alike for all commercially identical machine parts.

Cutting Tears Metal

Because metal cutting is a tearing operation so far as stresses are concerned, we find serious internal stresses in many machined parts. Finish machining or grinding rarely goes deep enough to remove the internally stressed metal from previous rough machining, and these finishing operations add stresses of their own.

Structural materials are not rigid. Many fatigue failures can be traced to elastic deflection for which no allowance was made in design. Bearings are frequently found to be plastically deformed or worn "bell mouthed" to accommodate the elastic gyrations of the crankshaft.

One thing is certain about gears as ordinarily designed: They will not function as intended. It is virtually impossible that the parallelism between mating teeth as visioned by the designer can exist in practice, for example.

From experience with practical machine parts we can only conclude that stress calculations by textbook methods are wholly inadequate until we generously temper our calculated results with experience. The accuracy of stress data from photo-elasticity, brittle lacquers, extensometers, and similar instrumentation is usually greater than by the involved mathematical analysis, but they are far from reliable.

Cannot Reproduce Conditions

The common belief that we can reproduce the conditions of service in a laboratory test is wholly erroneous. By the time the laboratory investigator on any particular part has provided for all the conditions that occur in service he will have a complete machine in actual service. The useful strength of materials in dynamically loaded parts is the fatigue strength of such parts under actual service conditions. No other measure will suffice.

No man can explain and substantiate the significance of fatigue tests in terms of the service strength of machine parts. Most machine parts that are plastically deformed are just as surely failed as if they were broken.

Fatigue data are mortality data and it is as absurd to expect that reliable actuarial tables can be constructed from mortality data on a half dozen individuals as to expect reliable comparisons from fatigue tests on a half dozen machine parts. Reliable life comparison of machine parts demands a large number of tests unless the life difference is very great. Yet nowhere in the literature do we find fatigue data approaching even the minimum requirements of reliability.

A Hypothesis

As a working hypothesis, it seems reasonable to assume, except possibly for very ductile metals, that:

The slope of the fatigue curve, as measured on a log-log plot, may be considered as a measure of effective stress and fatigue curves for varying stress concentrations converge toward a point near the tensile strength of the material and at some considerable number of stress cycles.

Laboratory fatigue testing of light-weight, high-output machine parts, as well as other laboratory tests such as on fuels, oils, tire wear, and so on, must be definitely correlated with service data on the part in question before the results can be accepted. Methods now used for coordinating laboratory tests with service experience are too haphazard to be completely reliable.

Fully 90% of all fatigue failures occurring in service or during laboratory and road tests are traceable to design and production defects and only the remaining 10% are primarily the responsibility of the metallurgist as defects in material, material specification, or heat treatment.

Joint Responsibility

Study of fatigue of materials is the joint duty of the *metallurgical, engineering, production* departments. There is no definite line between mechanical and metallurgical factors that contribute to fatigue. This over-

lapping of responsibility is not sufficiently understood.

Hence the engineers are constantly demanding new metallurgical miracles instead of correcting their own faults. Until metallurgists are less willing to look for metallurgical causes of fatigue and insist that equally competent examination for mechanical causes be made, we cannot hope to make full use of our engineering materials.

(Digest of "Improving the Fatigue Strength of Engine Parts.")

DISCUSSION

Mr. Almen's contention that stresses have only two components, tension and compression, and it is the tension and never the compression component that causes failure, even where the load is in torsion, was questioned vigorously by a number in the audience. Several seemed certain they had heard about them, but no one directly met Mr. Almen's challenge to produce an authenticated case where failure was caused by compression, not tension.

Harold Nutt, Borg and Beck Division, Borg-Warner Corp., wondered how the stress of machining was eliminated in making the stress studies. The best method, Mr. Almen answered, is by carefully honing and grinding, using the proper grits. This still leaves a small stress, but because its depth is very shallow, it has little effect in a large piece.

In reply to a question, the author said that he had no test data for cast iron, but he knew malleable acts as steel does in these tests.

In response to questions on the surface smoothness required before peening, Mr. Almen said that this had not yet been completely clarified, but he thought that one could probably start with a milled surface and come out with just as good effects as if the surface had been polished carefully before peening. Polishing, in fact, often does more harm than good because it may induce high surface stresses.

A question about quenching from Dr. T. H. Wickenden, International Nickel Co., was answered by the author with the remark that better automotive gears often result by quenching from the pot than from reheat. Dr. Wickenden pointed out that if local temperature goes above the critical point, soft spots will result from grinding.

The question of endurance values within the yield range was raised, and Mr. Almen replied that he had not carried out tests himself. But data from a British source resulted in diagrams similar to those the author obtained in his tests beyond the yield. D. E. Waite, Wallace Barnes Co., mentioned gun springs working within the yield that have been shot blasted, so as to be able to stand up for long enough periods. The shot blasting considerably improves the fatigue durability of the springs. In some instances test life increased from 3 to 20 hr, he said.

P. H. Richardson, Ranger Aircraft Engines, wondered if both surfaces should be shot blasted in, for example, two plates that are in contact. Mr. Almen said he believed it was probably necessary to shot blast only one surface, although it wouldn't hurt to do both. It is generally not necessary to finish the surface after shot blasting, he said.

Aircraft and Aircraft Engine

Chairman J. M. Shoemaker, chief project engineer of Vought-Sikorsky Aircraft Division, gave his overflow audience a program of six engineering expositions at the evening's combined Aircraft and Aircraft-Engine Session, introducing outstanding engineers of the aircraft, aircraft-engine, and automobile fields. The subject: Aircraft-Engine Installation Problems. Significance: Again, airplane, aircraft engine, and aircraft accessory engineers joined with engineers of long automobile and parts experience in discussing the intimate details of design, marking an historic step toward better correlation of engineering thinking on aircraft improvement.

(The paper on "Some Notes on Flap Control," prepared by F. V. H. Judd, Research Division, United Aircraft Corp., was withdrawn from publication by Government censors. Mr. Judd was permitted, however, to read his paper. Neither the paper nor discussion following its presentation will be published.)

Oil System Mock-Up Used as Bench Test Before Trial Flight

By HARPER D. SCRYMGEOUR,
Consolidated Aircraft Corp.

BENCH-TESTING of aircraft-engine lubricating systems under simulated altitude and temperature conditions demonstrated the advisability of this step before a new system is flown in development test work.

The entire lubricating system of a new bomber was mocked-up with an engine sump and pump run at a speed to supply 20 gpm that had been loaned by an engine manufacturer. A 10-gpm gear pump, to simulate the action of the cabin supercharger oil circulation pump, and a 1.5-gpm unit in lieu of the two turbo circulating pumps, were installed in the mock-up.

An airplane oil tank was then connected to the three pumps with lines closely simulating those in the bomber. This tank had an external electric heater, an internal heater, a hot air coil with air temperature control, several electric lights inside the tank, and a window for visual observation.

Five glass tubes were installed for observation of the condition of the oil throughout the system, and measuring instruments were installed along oil flow through the system.

Three complete sets of runs were made—one at 85 C, another at 95 C, and the third with 71 C as the average temperature. With no vacuum on the system, to simulate sea-level operation, then with the pump settings unchanged and vacuum applied to simulate 5000-ft altitude, and again at increments up to 40,000 ft, the phenomena of bubbling and foaming were observed.

As the altitude vacuum was increased, bubbling and foaming increased. During these observations, a change was made in the mock-up by substituting two "Y" connections for the plenum chamber connector. It proved to be a satisfactory change, and airplanes are now equipped with the substitute to ensure sufficient flow of oil as the vacuum was applied.

Another disclosure was that although at cooler temperatures the oil supply is smaller, the lubricant was in a more solid state, that is, with less foam and fewer bubbles. It was concluded that greater oil cooling capacity was desirable.

Although the frequency and size of air bubbles increased as vacuum was applied, simulating climb, some solid oil was present in all lines at all intervals.

Water was added to the oil in another test, and showed clearly that the emulsion resulting from 1.5% showed poor pumping characteristics. At 85 C, for example, the failure of the system occurred at a simulated altitude of 15,000 ft.

(Digest of "Operating Characteristics of Lubrication System for an Aircraft Powerplant Installation Under Simulated Altitude Conditions From Sea Level to 40,000 Feet.")

There was no discussion of Mr. Scrymgeour's paper.

High Altitude Flying Creates New Problems In Oil System Design

By H. E. MOERMAN,
Wright Aeronautical Corp.

HIGH-OUTPUT engines propelling planes at altitudes above 30,000 ft have introduced problems of satisfactory lubrication system design which demand serious immediate consideration. Temporary corrections entail certain disadvantages and require some flight research. Complete corrections are neither complex nor unreasonable, but they cannot be made immediately available without creating disadvantages of their own.

Recent research on airplane oil systems and work on oil pumps have revealed that the pumping characteristic of the engine pressure gear pump is largely dependent upon the condition of the oil at the pump inlet. Major factors limiting the gear pump's output are the pressure of the oil at the inlet and the percentage of entrained air.

A pump used on an engine requiring a given oil flow such that the pump capacity does not become marginal until its inlet is at 37,000 ft equivalent altitude declines in output, with 5% entrained air in the oil, when the inlet pressure becomes less than the atmospheric pressure equivalent to 20,000 ft. At greater altitudes the oil pressure will begin to fall off. With a suction value of 6 in. hg, such as is provided on many oil systems, the absolute pressure at the pump inlet will be the equivalent of 37,000 ft when the airplane is flying at 22,500 ft. By providing an oil inlet line of ample size with a minimum of turns, elbows, and miscellaneous fittings, it is possible to keep the suction to an absolute minimum so that the oil system itself imposes no penalty in pump output. In high-altitude oil system design, limitation of inlet line loss to 20% of the atmosphere appears desirable.

Simple expedient for improving altitude performance is tank pressurizing. A check valve is installed in the oil tank vent line between tank and engine. The engine scavenge pump serves as the pressure supply for the oil tank. If the check valve is set to maintain pressure of two lb sq in. pressure in the tank, the marginal altitude is increased approximately to 55,000 ft.

Since there are objections to applying this expedient to military planes having tanks

with bullet-proof cells, a more satisfactory solution is found in using a centrifugal-type boost pump operating directly in series with the pressure gear pump. The centrifugal type pump, which operates satisfactorily with almost zero absolute inlet pressure, would supply oil to the gear pump under pressure. In order to avoid redesign of present engine oil pump systems, the centrifugal boost pump might be mounted at the oil tank and electrically driven. In such an installation, electrical requirements might become excessive when attempting to pump oil at low temperatures.

Closely related problem is air entrainment, which causes loss of oil pressure, oil pressure fluctuations, and foaming in the oil tank. Expedients, chiefly in the form of splash plates, have been only partly successful. Recent tests have indicated the effectiveness of a centrifugal type separator, such as the Sharples Air Separator, now commercially available. This consists of a small cylindrical tank with tangential oil inlet and outlet connections and a vent for separated air. Scavenge oil enters at the top, rotates within the cylinder to form a vortex. The entrained air is released from the oil into the space above the vortex and, under scavenging pressure, is forced through the vent. The surface of the vortex then rises until its edges touch the blades of a small, lightly-spring-loaded rotor which, being turned, closes the air vent.

Effective separation is obtained down to 5% entrained air, but this represents a loss of 6 to 7% of oil pump output. Satisfactory operation of the Sharples separator depends upon maintaining the vortex, but this can be destroyed by sudden negative acceleration or inverted flight, temporarily stopping air separation and allowing oil to escape through the air vent. Further development may improve the effectiveness and adaptability of this separator.

(Digest of "Aircraft Oil Systems – High Altitude Problems.")

DISCUSSION

With a fearsome respect for gremlins, Emil Neubauer, Columbia University scientist, propounded the theory that these are four-dimensional creatures. Seal up a system as you will, and they'll get in to make trouble.

Several engineers agreed with the author that further development of oil separating equipment for airplane lubrication systems is needed.

Cooperative Design of Planes and Engines Is Short-cut to Progress

By HARRY KARCHER,
Allison Division, General Motors Corp.

AIRPLANES, once the feature attraction at county fairs, have become the most powerful weapons in war, and just as the Wright brothers worked together to win from Nature the secret of flight, so engineers must work together to make these flying weapons more effective.

This paper, presenting a plea for cooperative aircraft design, to outline methods for cooperation and to list the benefits resulting from co-designing aircraft powerplants, proposes that the drafting board be placed at the firewall, long regarded as the Mason-Dixon line separating airplane designers and engine builders. Simultaneous use there, free from respective professional egotisms and fixations, will reveal a mutual appreciation and understanding of design problems.

The mechanics of cooperative powerplant design calls for the continuous presence in the airplane design department of an engineering representative of the engine builder. Experienced in design, tests, and operations, and possessed of a reporter's curiosity, this representative engineer should function as a technical interviewer and carry the information over a two-way circuit between airplane manufacturer and engine builder. His reports would result in engineering revisions, production changes, and service bulletins. Potentially he would be the entire design, production, and service branches of the engine builder, whose appointment of a representative in the airplane plant would become a token of willingness to accept a share of the responsibility of both engine builder and airplane manufacturer for the overall performance of modern aircraft.

Maintenance and operation by engine builders of flight-test sections, as well as the flight-test programs carried out by them, are further evidence of the engine builders' interest in the airplane manufacturers' powerplant problems. Test reports of the engine builders' flight test section are reference data for the representative engineer, and case histories have influenced design.

The engine builder can supply desirable design assistance. He possesses well-grounded facts on vibration isolation, structural design and weight, and clearance and ease of engine removal. Test cell operations produce voluminous information. Rigid test stands have provided proving grounds far less sympathetic than the normal airframe structure in flight, making the engine builder a valuable consultant on engine mount design.

Proper engine lubrication and cooling come within the interest of the engine builder who hopes to duplicate in the airplane the test stand endurance record. The engine builder has a background of experience on other aircraft and knows their field operation history, making it possible for him to offer advice which will be helpful in improving plane performance characteristics.

The carburetor air inlet is a case in point. Designed from the airplane point of view it must have fair lines, low restriction of the field of vision, low drag, and simple and effective means of de-icing. The engine builder stresses good ramming diffusion, uniform air distribution at the flange, and elimination of boundary layer and organ-pipe effects. Collaboration between engine builder and airplane manufacturer can supply the latest engineering data and design assistance for the ultimate in scoop performance.

A hundred similar illustrations can be cited to illustrate conclusively the success of cooperation during the design stage as contrasted to the confusion of panic engineering once the airplane has reached the production stage. Despite the phantom barriers to co-designing unintentionally established by restricted, confidential, and secret design projects, the engine builder is ready and awaits only an invitation to participate in cooperative design recommended and approved by the military air forces.

(Digest of "Co-Designing Aircraft Powerplants.")

DISCUSSION

Discussion disclosed that although there is considerable interchange of design engineers among the airplane, engine, propeller, petroleum, and accessory industries, there is still considerable room for improvement.

John G. Lee, United Aircraft Corp., expressed the opinion that engineers are generally anxious to pool their experiences and ideas, but the opportunity under war emergency conditions did not permit enough of such conferences.

"Panic engineering:" Pressure on engineers to speed up improvements in design and manufacturing was thus labeled by H. Karcher, Allison Division, General Motors Corp., who urged caution.

'Environment' of Engine In Airplane Is Clue To Savings in Weight

By L. T. MILLER,
Glenn L. Martin Co.

DIFFERENCE in an engine's "environment" cannot be better demonstrated than by comparing test-stand operation and operation in the airplane. Although stand testing is valuable for a convenient arbitrary acceptance test, the engine must operate in an airplane, not on the stand.

Hence test-stand results must be translated into a form usable by the aircraft manufacturer. This translation is fully as important as the test-stand observations.

When thinking of an engine's environment we immediately recall the cowling, which brings to mind cooling – a problem which is with us always. Although the aircraft manufacturer can influence the degree of cooling available, he cannot cool the engine at low airspeeds or on the ground. Only by engine design can such cooling be obtained.

Engine cooling requirements must be within the ability of the aircraft manufacturer to cope with. In marginal cases, the engine builder must state the engine cooling requirements as accurately as possible.

Only by knowing the requirements can the aircraft manufacturer determine the necessary treatment to cool the engine.

Propulsion is not the sole requirement of an aircraft engine. Today, the airplane requires a complete powerplant. This powerplant must light, heat, and perform other duties around the airplane. It is always more economical to obtain power from the main engine instead of from a number of small auxiliary engines, in so far as weight is concerned.

If engine lightness is achieved at the expense of some heavy installations, the net result will be an overall *increase* in the

powerplant weight. Weight increases in the engine itself are welcome if this results in overall reduction of powerplant weight in the airplane. Basic engine design must be coordinated with the environment in which it must work. This is a clue to net savings in weight.

Startling savings can be made. For example, if we can obtain a 5% saving in fuel consumption for an airplane requiring 2400 total cruising hp, operating at a normal specific fuel consumption of 0.45 lb hp-hr, the fuel weight is reduced 1080 lb during a 20-hr flight. It has been estimated that a weight reduction of 1 lb on the DC-3 type will increase the revenue approximately $2000 during the airplane's life. Hence our weight reduction of 1080 lb means a revenue increase of over $2,000,000. The results with a fleet become staggering.

Results with military craft are more staggering because this saving is equivalent to a 1000 lb bomb, permitting another bomb to be carried. Thus one airplane could do the work of two carrying a single bomb each. Savings in manpower to produce the airplane, reduction in flight personnel, and simplifying the supply problem are among the possible gains through reduction in carburetor metering tolerances.

The engine manufacturer faces difficulties in obtaining this 5% improvement. However, when the possible effect is considered it is clear that almost any effort to improve carburetion is warranted. An improved carburetor may be worth a cost equivalent to the rest of the engine.

Most of the airplane's engine lubrication system is external to the engine. However, proper design of the system depends upon an exact statement of the engine requirements. It may be easier for all concerned if the engine manufacturer reduces the magnitude of the problem by his basic design.

Environment requires the powerplant to operate in the tropics and in subzero temperatures. Tropical operation requires sufficient cooling. Fortunately, adequate cold weather lubrication systems are available.

Ultimate objective is a successful, usable powerplant in the airplane. Environment plays a great part in the success of the powerplant, but engine design recognizing this environment may be the difference between success and failure in achieving a successful powerplant in the airplane.

(Digest of "The Effect of Environment on Aircraft Engine Design and Performance.")

DISCUSSION

It may be necessary for carburetor engineers to make an entirely different approach to engine carburetion, John G. Lee, United Aircraft research engineer, said. He said the engine engineers are anxious to get all the test data available, but we know too little about correcting these data to apply to various conditions. "Although the author doesn't seem to think test stand data are much good, at least we can repeat performance once in 40 times," he said.

A never-ending problem is the proper gear ratio. "This always ends up in a compromise, because there are so many variables, he said. In this W. E. Burnham, vice-president of Freedman-Burnham Engrg. Corp., concurred. "The important consideration is the thrust. All of us must give more careful consideration to propeller gears," he said. An Utopian solution to most aircraft engineering problems would be a "conference of the airplane, engine, and accessory engineers *before* the drawings of a new plane were begun." Mr. Burnham had no immediate hopes of such an empyreal state of affairs, particularly under war conditions.

Several of the discussers pointed out that we are too prone to blame excessive drag on the other fellow's design without realizing that few have a clean bill of health in this respect.

William C. Lawrence, American Airlines, pointed out that fuel consumption was not solely the responsibility of the carburetor engineer. "Maximum operating economy requires both good carburetion and installation. Both must be improved. We need better fuel flow meters, and study to determine what specifications are needed for metering," he continued. Robert Ray Higginbotham, Republic Aviation Corp., said that tolerance in metering at a given horsepower may mean a baffle pressure drop of several inches.

Otto E. Kirchner, American Airlines, questioned Mr. Miller's figure of $2000 revenue earned by a transport for every pound of weight saved. He thought one-eighth of this might be a better figure. This figure, the author said, was used by a transoceanic airline, and was given as an example. Obviously, he said, the longer the scheduled run the more the saving would amount to.

Discussing this point, Mr. Lawrence pointed out that commercial aircraft generally use selective settings which are automatically maintained on long runs.

Mr. Shoemaker closed the meeting at 11:13 p.m.

Coordination of Makers Of Components Required To Build Better Craft

By T. HAMMEN, JR.,
Ranger Aircraft Engines
Division of Fairchild Engine
& Airplane Corp.

THE rapid increase in airplane performance, with special reference to high speed and high operating altitude, has greatly increased the importance of the powerplant and its installation in the overall picture of airplane design. Airplane propulsion – engine, propeller, fuel system, oil system, cooling system, etc. – may represent 40% of the gross weight of the airplane. Total drag at high speed due to engine and oil cooling may be as high as 10%. At take-off and climbing speeds the percentage of the total drag may be even higher because of the cowl and/or radiator flaps.

Weight has marked effect upon the climb and ceiling. In some instances, these are of utmost importance. Drag, on the other hand, has its largest effect upon the high-speed performance of airplanes. It has a considerable effect upon climb and "single engine" performance.

If the opening of the cowl flaps for climbing operations adds 50 hp to the power required, it means that an extra 50 thrust hp, or perhaps 65 bhp must be obtained if the same rate of climb is to be maintained as with the cowl flaps in the closed position.

Propulsive efficiency depends on:

a. Propeller blade design characteristics,
b. Propeller diameter,
c. Propeller rotational speed,
d. Airplane speed,
e. Altitude or density, and
f. Body interference

Of these factors, b, c, and f depend to some extent upon the engine design.

The airplane does not know whether a given thrust horsepower, say 400 thp, is obtained with an engine of 800 bhp and a propulsive efficiency of 0.50, or with an engine power of 500 bhp and a propulsive efficiency of 0.80. Hence, judicious design involves much more than only an increase in engine power when higher performance is required.

Proper Combination

Airplane performance can only be obtained by proper combination of airframe, engine, and propeller. The combination should be properly joined or "installed" if the best results are to be obtained. Adequate cooperation among the airframe, engine and propeller engineers is required. Such cooperation will call for a number of compromises. The "customer" serves as an arbitrator.

The manufacturer of Army or Navy aircraft might be called the "middle man," because he has to guarantee the performance of his product on the basis of computations which depend to such a large extent upon engines and propellers – not under his direct control. For the good of the war effort and in his own interests, he should make every practicable attempt to coordinate the efforts of the engine, propeller, accessory, and equipment manufacturers.

The engine manufacturer should supply the highest power with the lowest weight. The engine should operate with low specific fuel and oil consumptions. The frontal area and overall dimensions of the engine should be kept small. For a given conventional, single-engine airplane, these methods provide for a large-diameter propeller: Increasing the height of the landing gear, gulling the wings, and using an engine with a suitable propeller shaft offset. The latter method is least apt to lead to heavy, performance-reducing complications, however.

Propeller manufacturers should provide propellers with high thrusts and efficiencies at all operating speeds and altitudes at a minimum weight. They should provide ample pitch range with suitable pitch control. Full feathering propellers of the "self-contained" type have much to offer if they are not too heavy. They add as much as 12 or 15% to the single engine ceiling of the ship.

Reliability and maintenance should not be forgotten. On the other hand, it is not believed good practice under the present war conditions to sacrifice performance in order to obtain unlimited life for *combat* aircraft. But intelligent compromise is required. Both reliability and maintenance would be improved by "Integral Power Plant Installations" or "Unit Power Plant Installations". Such installations provide interchangeability and promote "quick change" features.

There are at least three methods of overcoming the high altitude cooling problem besides increasing the fuel-air-mixture ratio. One is to use fans or blowers to obtain the additional pressure drop required. The second is to use exhaust jet expulsion to increase the pressure drop. The third is to improve the cylinder fans and baffles. Blast tube installations indicate that a combination

of two or more of these offer best solution.

Fuel systems having sharp bends are apt to cause trouble at high altitudes, especially if the lines are subjected to heat, because more vapor may be released than the carburetor can handle. High spots, where vapor traps can occur, should be eliminated, and lines should be kept away from hot portions of the engine. Relocating the fuel pump from the engine to a point near the tank is effective. Thus the most critical portion of the system is well pressurized. Vapor locking limits the climb and ceiling.

When proper plumbing is employed, oil systems will usually function satisfactorily if sufficient suspended air is removed prior to the pressure pump.

A German installation, which contains a separate pump to take the oil from the tank to the cooler, suggests these advantages:

Probable increase in cooler efficiency because of less air in the oil, and proper rate of flow,

The oil has a second chance to give off air when it is returned to the tank, and

The capacity of the scavenge pump is increased because of the reduced head at its outlet.

Water in oil can be minimized by providing adequate ventilation and by keeping the oil temperatures in the crankcase above the dewpoint of the atmosphere adjacent to the oil.

(Digest of "General Aspects of Aircraft Powerplant Installations.")

DISCUSSION

When called upon by Chairman Shoemaker for discussion of this paper, several engineers congratulated the author for his effective plea for greater coordination of engineering thinking in aircraft design. "I think you will see considerable improvement this year," one engineer remarked from the rear of the room.

■

Aircraft

Far reaching in its significance were the "production-design" philosophy, offered to aircraft designers by the second speaker, and the idea of designing easier maintenance into aircraft, by the first speaker, at the Friday morning session presided over by Robert Woods, Bell Aircraft Corp. Although Mr. Woods closed the discussion at 12:30, groups informally went over his points at lunch and all through the day. Several said that it was one of the most important contributions to aircraft production propounded to date.

Easier Maintenance Made One Objective Of Airplane Design

By N. L. KEARNEY,
Curtiss-Wright Corp., Airplane Division

DESIGNERS of fighter airplanes must give thought to ease of maintenance if maintenance mechanics are to keep the planes in flying and fighting condition.

When the field mechanic finds that before he can remove and service a propeller governor he must remove the propeller at a cost of two or three hours, you can't blame him for using explosive language.

If replacement of some gadget in a junction box requires removal of the junction box and connecting conduits, the designer has not demonstrated proper sympathy for maintenance problems. Progress made in the past few years to help the maintenance man includes:

Fewer disconnects to be made to remove a unit;

A few cowl fasteners in lieu of a flock of screws;

Engine mount assemblies to be removed as an assembly rather than removing the engine from the mount; and

Quickly replaceable wing tips, among others.

However, there is still plenty of room for improvement, if maintenance time is to be cut to the minimum. Answers are to be found largely in a study of detail design, and mechanics in shop and field often offer helpful suggestions which may excusably be overlooked by draftsman and designer.

Education is Important

Education of field personnel in proper servicing is a most important prerequisite of good maintenance and repair. Before the United States entered this war, American, British, and Canadian armed forces sent small groups of selected non-commissioned men to manufacturing plants for short familiarization courses. They became instructors in the field. When we entered this war, factory training on specific models was begun on a larger scale, and through the AAF Technical Training Command, schools have been established at many plants with a student body of 500 or more for 30-day training periods. This specific training by the manufacturers' civilian personnel supplements the previous method of five or six months of training in Army basic schools.

To supply information direct to the fields, the Technical Training Command, with the assistance of manufacturers, has put some Mobile Training Units on the road. They carry a corps of instructors plus working mock-ups, educational films and literature, and move from one operating unit to another.

Use of technical observers is producing great dividends in this war. These men are mostly service representatives sent out by manufacturers at the direction of the armed forces. They are civilian employees sent out into the field to assist the armed forces. When they are sent abroad they are given the official status of technical observers, are required to wear the uniform without insignia of commissioned officers.

Through military channels these men keep in close touch with their factories and with military command in this country. Their reports frequently influence design changes, and they return to the factory often enough to keep familiar with latest models. Thus they constitute a messenger service from the battlefront which enables the manufacturer to correct defects and improve subsequent models.

Tools and Parts

Tools and spare parts are of utmost importance in keeping equipment operating. The lack of spares has kept a tremendous number of airplanes on the ground. It is difficult to forecast the spares that may be needed, and in actual practice on overseas flying fields the main supply of spares is obtained by stripping wrecked airplanes of usable parts. This spares-and-supply problem has many angles only disclosed by actual war operations. For instance, while the original spares list and quantities may have been excellent, it did not anticipate that a supply ship might be lost, or that crates of spares would be buried in Libyan sands to protect them from enemy aircraft, and then could not be found.

The identification and ordering of spares and replacements requires simple language, to get *what* you want *when* you want it. An answer to this problem has been illustrated parts catalogs for airplanes. But there is little of this illustrated information in the field, and it is much needed both for maintenance and repair. No one can be blamed for ordering more parts than needed in the hope of getting the part he really needs; in one case, where an operating unit needed only a rudder control cable, it was found that the parts list gave a whole page of control cables with no other identification. So they ordered the whole list and got what they wanted – plus a lot of unneeded cables.

Climate and Design

Maintenance and repair in war are usually done under all sorts of adverse climatic conditions. Again, climatic conditions may have a lot to do with detail design. We now equip airplanes with 10 or more changes to make them part way satisfactory for desert operation, and there are that many or more changes necessary for subzero operation. Sand and extreme cold weather are enemies which take real engineering to overcome.

Practically all work both at the front lines and back at the Maintenance and Repair Units is done in the open, regardless of climate. Efforts are usually made to establish some sort of building protection further back for erection and major repairs, but this is not always available.

Minor repairs are made in the front lines in the quickest and easiest way possible to permit the airplane to re-enter the fight, or to be ferried back to the main repair base.

But there is probably no effort to make major repairs on fighter planes. In the majority of cases, it is believed that the repair of each cracked up airplane is handled as an individual problem, and effort is directed to put it back in combat condition by repairing or replacing its damaged units.

However, in one British maintenance unit in Egypt, the boys introduced a variation. Each crack-up brought in for repair was completely disassembled, all parts cleaned and inspected. Parts passing inspection were properly identified and placed in stock bins. A production assembly line was started which produced a continuous flow of rebuilt airplanes. Reports indicate that this plan has been very successful.

(Digest of "Field Maintenance and Repair of Fighting Airplanes.")

DISCUSSION

Should parts which are slightly different, but which are interchangeable and function similarly in the field, have the same part number was the question asked of Mr. Kearney by H. C. Aument, Jr., Roosevelt Field, and Eugene Laas, Chandler-Evans Corp.

Mr. Kearney feels that they should have a different order number, as this will make it easier to know which one failed in the field. Mr. Aument reported that the question of interchangeability has partially been taken care of by some manufacturers who advise: "When this part is exhausted, use part No. x."

'Production-Design' Is New Task of Aero Engineers To Meet War's Demands

By **HAROLD M. HARRISON,**
Lockheed Aircraft Corp.

UNTIL recently our industry was engaged in converting peacetime machines to war production. Our present design job is to add the consideration of mass production to the initial design of our products or production design. The objective is a clear one – to provide in the design for the practical attainment of maximum overall economy in the production of our article.

In the old days a designer, feeling the need of production advice, contacted his favorite foreman in the shop. He would reflect that foreman's advice into his design, and if questioned about it later, would say, "This is what the shop wants."

As the industry expanded, tool designers were employed and later actual tool design departments and tool planning groups were set up. Coordination was set up between them and engineering. As the volume increased the tool design departments assigned personnel to the engineering departments as a full-time job for the sole purpose of representing factory interests. Many concerns are still operating at this stage very satisfactorily, depending on the qualifications of the personnel involved.

On the other hand, a man with sheet metal experience would be likely to advise a designer in directions which would penalize the welding shop, and so forth. Another fallacy existed in this method; it was noticed that when alternate designs were submitted by the engineering department for factory choice, the type selected naturally was the least difficult, whereas the alternate, even though difficult to achieve, often represented considerable net savings to the company.

The organization of the production designers themselves consists of one man responsible for the production design of a project. He is called the project production engineer. Men are assigned to the major groups under him as needed. Where the load requires it, this results in the assignment of one man for each major group on the project.

Production Design Philosophy

Embodied in the principles of production design are the results of experience gained during years of eliminating production troubles.

The designer is implored to treat all units as *free bodies*. Parts and assemblies must be designed to fulfill their purpose with consideration of each as a unit complete within itself, considering adiacent structure only to the extent of attachment and clearance.

Airplane components (fuselages, booms, nacelles, etc.) should be designed of *circular cross sections* with straight centerlines when feasible. This provides for easier production and permits the standardization and multiple usage of parts.

The importance of *accessibility* for assembly and installation is stressed. To provide for it we must design for *breakdown* into subassemblies.

Joints between assemblies should consist of a *few concentrated point attachments* rather than a series of attachments.

(Digest of "A Method of Applying Production Design to Aircraft.")

DISCUSSION

For the first time, an engineering approach was made to the problem of aircraft production design. Discussion from the floor showed clearly that production engineers should get into the design during early stages, and work out a master plan to show how the components can best be put together. The design engineer must be told that each component part is an entity, and must be drawn as such, if inexperienced workers are to accomplish the task ahead.

J. M. Shoemaker, Chance-Vought Aircraft, questioned Mr. Harrison's statement that the use of specialists in the production engineering department did not work out. If everything works through one channel, he asked, don't you get into the problem of not having each of your production men competent in *all* branches?

With respect to the use of specialists, answered Mr. Harrison, they are actually members of these groups, but they do not contact the designer directly. However, close coordination must definitely be kept with the specialists.

Avoiding Human Errors

W. A. Bennett, East-West Consultants, feels that the only way to obtain accurate manufacturing relations in the manufacturing end is through the use of a master dummy and keeping the human element out of it as much as possible. Where you haven't the control of all parts in your own plant, it is of great importance that the structure be planned right from the root to the finished product.

Master tooling is absolutely essential to subcontracting and sub-subcontracting, declared Mr. Harrison. In this case the designer is able to help out by planning in such a way that close tolerances do not have to be held. What engineers, tooling men and subcontractors really want is the application of generous tolerances throughout. Mr. Bennett agreed with this, stating that if subcontractors are given high and low tolerances, they are able to make allowances and considerations at their own particular points.

The proper coordination of separate assemblies so that they can be properly matched together, cautioned Mr. Harrison, is of utmost importance.

The position of standards in one of Mr. Harrison's slides was questioned by C. E. Stryker, Aircraft Production Board. Mr. Stryker felt that standards should be considered of greater importance at the beginning of a project rather than having their importance realized as the work progresses. In regard to some methods of simpler production design, Mr. Stryker wondered if in the effort to make parts simpler, we do not increase the weight.

Standards, Mr. Harrison agreed, are one of the most important tools in production engineering, and as such are given a most important position. The seemingly unimportant position of standards on the slide in question was due to nothing more than lack of space. As for the weight problem, Mr. Harrison believes that you will actually save weight every time on the aggregate gross assembly. If records were kept, you would find that the overall, complete job would really show a saving in weight, he said.

J. T. Parsons, The Parsons Co., wondered why we should question a design six months or a year after the plane is in production. Subcontractors and sub-subcontractors must be employed, and when you start breaking down details without all the information at hand, you're using time not alone in subcontracting, but in sub-subcontracting as well. Thought should have been given to the clarity of the blueprints.

The depiction and portrayal problem is of greatest importance, answered Mr. Harrison. Getting physical requirements specified in depiction and portrayal naturally falls into the hands of the production man because he should know what the factory wants. He should bear in mind that his design must have consistency and clarity. Blueprints, themselves, he said, are not routed through the fabrication shop at all.

It was brought out that while it is true blueprints do not get very wide circulation in the shop, the drawing must be made with the inspector in mind even more than the fabrication man, because the farther down into subcontracting you get, the more they work with the blueprint.

■

Aircraft Engine

Seldom has any engineering audience had the opportunity of hearing the results of such a comprehensive and illuminating paper as the first in this session, and the second opened thinking of many engineers to wider application of a standard manufacturing method. Chairman Raymond W. Young's invitation of discussion from the floor brought a dozen men to their feet, and the meeting was closed long after scheduled time.

Working Temperatures Of Portions of Parts Held Clue to Design

By **E. J. WILLIS and R. G. ANDERSON,**
Aluminum Co. of America

INTELLIGENT improvement of aircraft-engine design can be made when working temperatures at particular localities of a part can be more accurately determined. Study of these points will result in lighter engines, a basic aspiration of all aeronautical engine designers and aircraft manufacturers.

Because certain localities of an aluminum engine part may run at much higher temperatures than other points of the same part, stresses of those particular localities must be known before any important improvement can be expected.

By taking a cylinder of known aluminum alloy and heat-treatment, and known hours of service and running temperatures, Brinell tests disclose the temperatures encountered at any given spot.

But because of the complicated structure of an aircraft engine, many stress concentrations are introduced by mating parts and sharp radii. Hence cylinder-barrel threads, which produce a large number of stress concentrations, should match in contour and

pitch at the *operating* temperatures of the joint rather than at shrink or room temperatures.

Flange and studs in the aluminum provide a better fit of the exhaust pipe to the cylinder head for large engines than do shrink fits, because cylinder-head assemblies flex considerably in operation and a flexible joint is required.

The Brinell test was applied to many used aluminum pistons, and the average results showed that a wide range of operating temperatures are met by the piston while in operation. These tests were followed by stress testing where extensometers, brittle lacquers, and wire strain gages were used. These showed great concentration of stresses in operation.

Most of the stresses in pistons are of a fatigue nature, and pistons should be designed on the material's fatigue strength at the *temperature of operation*.

Study of aluminum crankcases disclosed the uneven loads hold-down studs are called upon to carry. Two studs over the diaphragm, for example, carry nearly twice the average for all studs. This calls for redesign. Experiments with a ring nut instead of hold-down studs, similar to the German DB-601 engine, indicate the value of this method.

Only the surface has been scratched in the study of temperature and stress measurements, and engineers are urged to amplify this field of investigation to determine optimum design.

(Digest of "Operating Temperatures and Stresses of Aluminum Aircraft-Engine Parts.")

DISCUSSION

Stud loads, described and charted in the paper, were measured first on a single cylinder and again with multiples. The measure was made of the deformation of each stud, Mr. Anderson replied in answer to a question by Prof. E. S. Taylor, Massachusetts Institute of Technology. Elongations of the stud were measured from the case by using an extensometer and the elongations were added to arrive at the resultant load.

J. O. Almen, General Motors Research, said that if the studs were tightened properly in the first place there would have been no excessive load. "There is always danger in putting too much confidence in the laboratory tests," he said. "However, this paper represents an excellent approach to the problem and is an important contribution to our thinking," he observed.

John W. Oehrli, Pennsylvania State College, suggested that some radical method of cylinder cooling be tried. He suggested holding the piston stationary and reciprocating the rest of the parts in order to permit more room for thermocouples in such tests.

Gear Shaving Seen As Hope For Faster Aero Engine Output

By A. W. HARRIS,
Chevrolet Motor Division,
General Motors Corp.

ADOPTION of the gear shaving process for manufacturing aircraft engines would permit the use of many existing machine tools, would materially reduce manufacturing costs, and would speed up production.

Preliminary work at the request of the War Department has been done. Results indicate that the automotive technique developed during the past 12 years by Chevrolet to get smoother tooth contact of transmission gears can be adopted for the manufacture of aircraft engines.

The major objection raised by the aircraft industry to shaved gears appears to center around the probability of distortion during the heat-treatment following the finish of the gear tooth form. If this means expansion, sometimes at a uniform, at other times a non-uniform degree, heat-treating procedure can be changed to make expansion more uniform and an allowance can be introduced in cutting the gear to compensate for the known degree of expansion.

Probability of highly concentrated stresses due to cutter marks and the line of demarcation between the hobbed and shaved contour in the tooth fillet is another objection sometimes raised. In the automotive transmission development, a 14-tooth pinion driving a 33-tooth gear was replaced by a 13-tooth pinion cut from the same blank. The heavy tip contact that had been an abiding problem virtually disappeared.

Of itself, the shaving process does not produce the gear tooth profile, as grinding does. Thus the preliminary hobbed or shaped form must be carefully controlled to obtain a good shaved gear.

In general, grinding gears depends more upon competent workmen than does shaving. In the face of the manpower shortage this is an important consideration for volume production. On large runs the shaving process shows up the best, as compared with grinding, production has proved.

Gears of small diameter with relatively heavy web sections centered under the tooth, should be first chosen for shaving. Chevrolet is leaving larger gears with light sections – approaching the designer's ideal of a halo mounted on a spider's web – for future consideration. Small stub-tooth gears having less than 1.3 teeth in contact are not suitable for shaving if it is important to maintain a true involute form.

(Digest of "The Possibilities of Shaved Gears for Aircraft Engines.")

DISCUSSION

Gustaf Carvelli, Wright Aeronautical Corp., clarified a confused issue when he asked the author what experience he had to report on shaving nitrided and carburized gears. Mr. Harris pointed out that his work had not covered such blanks. However, the author said, there are a number of aircraft gears that lend themselves to shaving.

Mr. Carvelli pointed out that his experience had shown many simple pinions can be shaved satisfactorily. The slightly soft surface has some advantage during the run-in period, but as shaved and ground gears go up to the point of destruction, there seems no difference in performance.

G. H. Sanborn, Fellows Gear Shaper Co., believed that quality cannot be temporized with, and felt that the machine tool bottleneck in this respect was far-fetched.

Charles G. Pfeffer, Wright Aeronautical Corp., showed several slides giving typical examples of aircraft gear sections. All previous automotive vehicle gear manufacturing experience cannot be applied to aircraft engine gears without thorough and complete tests. It is probable, he said, that the flexibility of the grinding process, adopted in the aircraft engine industry eight or nine years ago, established this practice rather firmly. Some gears will be shaved, others must be ground, he believes.

Design Affects Distortion

Distortion, Mr. Pfeffer warned, is a matter of design and preparation of gear blanks rather than one of chemical analysis. A dependable indication of probable distortion would be the measure of hardenability. Absolute control of distortion would require the making of only one blank from a heat – a patent impracticability.

In the experience of Foote Bros. Gear & Machine Corp., Arthur Mackman said, better results had been obtained in shaving after carburizing than before. This he attributed to the carbon in the surface of the teeth. A hardness of about 200 Brinell seems satisfactory, he said. He suggested this rule:

"Grind whenever you can, and shave only when you can't grind – such as on double and triple cluster gears."

Andrew V. D. Willgoos, Pratt & Whitney Aircraft, in a written discussion read by Arthur A. Brown of his company, held that there are no grounds for controversy between shaving and grinding. He summarized:

Shaving is desirable where, because of the design, a hardened gear cannot be ground:

Shaving is desirable on gears which do not require hardening, and where a saving of time and equipment, or both, can be effected, and

Shaving is acceptable on hardened gears wherein accuracy can be maintained and where production is sufficient to warrant use of complicated quenching fixtures.

Allison Division, General Motors Corp., shaves 18 gears, of which nine are for oil pump and three for service only. Seven other gears are released for shaving. On a new model 15 gears have been released for shaving, six of which are oil pump units. Rotary type equipment is used, and a shave of from 0.001 to 0.002 in. a side is being made. L. V. Cram of Allison would be interested in knowing about elliptoid shaving.

R. B. Hubbard, Ranger Aircraft Engine Division, is using 16 shaved gears in the 12-cyl engine, and concluded that this was the limit after a recent restudy of the ques-

"Designer's ideal of a halo mounted on a spider's web:" A. W. Harris, Chevrolet Motor Division, thus described ring gears and the like that may be a designer's dream but become a production engineer's nightmare.

tion of shaving more gears. Some could be shaved by redesign, he thought, but not without adding weight.

Several engineers agreed that since accuracy is of prime importance, and the degree of hardness also will determine its acceptance, unless the gear is accurate the method is unimportant.

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Aircraft

Chairman Harold D. Hoekstra, Civil Aeronautics Administration, served a technical fare of significance in a paper on propeller testing *via* electronics, and another on pre-rotation of tires. The debris cluttering the thinking of engineers on the latter subject was swept away deftly by the report of important pioneering work which forms the foundation for future work, and may well chart the course for future engineering thinking.

Electronic Test Method Is Found for Simulating Operation of Propellers

By RALPH M. GUERKE and GEORGE P. KNAPP,
Curtiss-Wright Corp., Propeller Division, Caldwell, N. J.

ENDURANCE testing of finished structures or component parts is as important as testing structural materials, but has been given much less attention in the literature. Much is performed on proving grounds, in test houses and under actual service conditions, where many more uncontrollable variables are involved than in a laboratory test. The laboratory also permits testing individual parts without testing the complete assembly, saving time and expense.

Most fatigue test machines are of the "brute force" type. Rotating or reciprocating parts apply a force or moment comparable in magnitude to and often larger than the force required to produce a static stress of equal magnitude. The vibratory forces produced by these machines are normally carried by bearings, and consequently the machine is of heavy construction to outlive enough test specimens to justify its cost.

Numerous arguments favor endurance testing machines which operate at resonance, particularly when testing finished parts. These include accelerated testing through higher speed operation, more realistic stress distribution, and decreased vibrator thrust requirements.

The problem of maintaining constant exciting frequency and the fact that changes in amplitude of the driving force at constant frequency could not be accomplished with the apparatus running, led to the development of the equipment and technique now in use.

Vibratory excitation is applied to the specimen under test in different ways and under different conditions in the static test from those encountered under actual engine operating conditions. The vibratory strain distribution in a blade under static test can be made to resemble that distribution encountered under actual operating conditions, although mode and frequency of vibration usually differ radically.

The system employs electromagnetic translational vibrators powered by large vacuum tube amplifiers which are in turn excited by stable electronic oscillators. Because of its connection to a resonant load, the armature becomes a part of the resonant system, and the inertia forces on the armature usually greatly exceed the electromagnetic forces. The test specimen shakes the vibrator. The armature frame must be non-magnetic and should preferably also be a good conductor of heat, poor conductor of electricity, and capable of withstanding temperatures as high as 150 deg C for indefinite periods. Stainless steel is quite satisfactory.

Safety Features

Several safety features in the amplifier circuit protect it against damage by an untrained operator: An electronic voltage limiting circuit which automatically reduces the amplifier gain if too high a voltage is applied to the input; spark gaps that protect the amplifier against an open circuit; an overload relay to protect against a short circuit. Time delay relays apply voltages to various circuits of the amplifier in the proper sequence.

Output of the resistance tuned oscillators ordinarily used to excite the power amplifiers is smoothly adjustable in frequency and amplitude. Vibratory strains are measured by electrical strain gages of the wire or carbon resistance type, whose output is amplified and appears on the screen of a cathode ray oscilloscope. Amplitude is measured by a calibrated microscope.

When a blade is tested, the endurance test is preceded by a stress survey. Strain gages are mounted at close intervals throughout the length of the blade on both the thrust and camber faces; the blade is then suspended and vibrated at low power. When the maximum strain has been determined, all except a control gage is removed, and the endurance test is commenced.

When it is desired merely to locate the maximum strain point without determining the strain relationships, the desired frequency is located by ear and the excitation removed. A coat of brittle lacquer is then applied, excitation again is applied and increased in amplitude until the lacquer cracks.

A machine for testing blade retention has been developed where the steady centrifugal forces on the shank are reproducible in a static test.

Properly interpreted, endurance tests are of definite value, particularly when reproducible service conditions are simulated. Improvements in design are being made possible which otherwise would have to wait upon service reports. A laboratory test may be even better.

Ease and reliability of control, not only of amplitude and frequency, but of location of the point of maximum stress, are thus important requirements of a machine or techniques for fatigue testing of finished parts, and in these respects, the two years in which Curtiss has used electronically controlled fatigue equipment have proved its cost amply justified.

(Digest of "An Electronic Method for Endurance Testing of Propeller Components.")

DISCUSSION

J. O. Almen, General Motors Research, questioned the benefit derived from conducting these tests at high frequencies. Why couldn't high amplitude and low frequency be used just as well, he inquired. It is impossible to reproduce service conditions in the laboratory, he said; hence it is immaterial what the instrument is.

In conducting these endurance tests, answered Mr. Knapp, who presented the paper, they have not been attempting only to make the material last, but to give a number of cycles rather than a definite life. He believed that the General Motors system at present is predicated on a definite life of the various components, which endurance life is never exceeded during the normal life of the vehicle. He considered that if no failure occurs at 10,000,000 cycles, no failure will occur at all.

In establishing a point at 10,000,000 cycles, asked Mr. Almen, are you assuming that you have established the actual stress magnitude that occurs in service? He believed the same results can be obtained on simpler and less costly mechanism.

In answer to W. E. Burnham, Freedman-Burnham Engineering Corp., as to whether any thought has been given to correlating the failure occurring by the electronic method as compared to failures from an endurance test, Mr. Knapp said that actually laboratory tests are set up in order to duplicate conditions which in general have already been reported in the field. For example, if a failure is going to occur at a certain point, it is possible to set up the test that way. "We can then incorporate whatever effective methods are necessary," he said. That is as close as they have gone in any type of correction, Mr. Knapp reported. Mr. Burnham said that if we have a condition of natural frequency, we should be able to find it by this electronic method.

From a manufacturer's requirement standpoint, R. A. Cole, Wright Aeronautical Corp., admitted that it sounded good. However, the propeller industry in this country has reached an ability to measure actual strain in actual service conditions. Also, the propeller industry cannot afford to have failures because when the blade comes out of the propeller, if it breaks off at the shank the unbalance is usually great enough to necessitate taking the engine out of the plane. For that reason you usually don't find out too well where your failure limit lies in service.

Preventing Failures

"We cannot wait until failure actually occurs," said Mr. Knapp, "before trying to improve design. The amount of power transferred is so variable that it is hard to give any definite figure."

It is perfectly true that we have no way of duplicating the steady centrifugal load and thrust loading on the blade so that our tests may have somewhat of a skulduggery appearance, admitted Mr. Knapp in answer to Morley Lazier, Massey-Harris Co., but we do find we can make failures occur where we expect the stress will be the maximum.

"Do synthetic failures have the same appearances as natural ones?" asked Mr. Lazier, "and do you feel that it's a perfect way of duplicating field conditions?"

Mr. Knapp answered that he cannot defi-

nitely say there is any similarity, but that conditions can be obtained which are definitely applicable to design.

Pre-rotating Plane Tires Offers Hope Of Marginal Gains

By C. R. MASON and W. H. ELLIOTT, B. F. Goodrich Co.

TIRE pre-rotation means rubber conservation to many people, especially now when we are developing ideas for conservation.

Preliminary work done to date indicates that safety and increased tire life are two good reasons for pre-rotation.

Four ideas developed to pre-rotate tires:

1. Use of vanes cemented on sidewalls of tires,
2. Wind motor drive,
3. Flexible shaft power take-off from motor, and
4. Motor-driven wheels.

Manufacturers attempt to build the following characteristics into a commercial airplane tire:

Minimum material weight per lb of carrying capacity,
Resistance to bruising,
Bead strength,
Control of chipping, cutting, and wear on tread by compounding the tread stock, detailed tread design and inflated contour, and geometric layout of carcass cords,
Flotation,
Balance, and
Deflection.

Tread cutting and punctures are responsible for more removals than any other causes. Flat spotting as a result of brakes is caused by landing the plane with brakes partially applied and stopping the plane too fast. Bruises are the result of a severe impact sustained during either take-off or landing. The condition of landing fields during the winter is conducive to more bruises than during the summer, when landing fields are kept in better shape. Chafed and blown out beads seldom occur in present-day tires. A tight fit on rims, with beads constructed to prevent rocking action, minimizes the possibility of this type of failure occurring.

The cost of a mechanical pre-rotating device has not yet been figured, due to lack of information. Pre-rotation of landing wheel tires must show an improvement of 20% to be worthy of consideration. Vaned tires are not worthy of consideration, because of the added cost which might easily be higher than shown. The weight of any mechanical pre-rotating device should not be more than 10 lb per plane to be economical, assuming a 20% improvement could be shown. The data would indicate that the service conditions of high deflection, fast acceleration, fast deceleration, coupled with hard usage of brakes, brings about an exceptionally fast tread wear condition.

(Digest of "Pre-rotation of Landing Wheel Tires.")

DISCUSSION

Chairman Hoekstra said that this was the first paper ever presented on pre-rotation. "It is particularly important because new landing techniques require design changes."

R. L. McBrien, United Air Lines, remarked that the speed indicator and rate of descent shown in the film registered speed at contact from 80 to 85 mph. On the control of descent in the conventional three-point landing speed was in the nature of 65 mph. This was at Cheyenne, at about 6100 ft above sea level.

R. C. McGuire of American Airlines asked what effect pre-rotation of wheels and tires will have on tire cuts. They found, he reported, that approximately 75% of our troubles are due to cut tires, and these cuts were attributed to foreign objects on the airport runways. Although we very seldom have out-of-balance problems, we are attempting to reduce this by making tire repairs more frequently. "We have quite a number of tires to repair because the plane has been stopped clear out of balance." Mr. Elliott, who presented the paper, said he hoped to have some answer to that in the near future.

In answer to H. W. Bonnett, Reybestos-Manhattan, Inc., Mr. Elliott said a definite answer as to how great a deceleration is practical is not given serious consideration, because safety is the No. 1 factor always; tire conservation is secondary.

The co-author was asked how much more load the brakes would be required to absorb due to pre-rotation, and he placed the figure at around 40,000 ft per lb, which is relatively small.

C. E. Stryker, Aircraft Production Board, commented that there was no figure in one of Mr. Elliott's charts for brake maintenance. Would pre-rotation have some effect on brake maintenance which should be included on the chart, he asked. Mr. Elliott said they had not entered into this at all.

The impact effect between tire and ground is well below the stresses which the landing gear must stand, said R. D. Evans, Goodyear Tire & Rubber Co. Furthermore, tests his company has concluded show that the loss of rubber in lb per miles was slightly greater in automobiles than for airplanes.

Two 1700x16 air transport tires were exhibited. One tire was equipped with rubber vanes which pre-rotated the tire prior to landing.

Tire Pre-rotation

When you work at pre-rotation,
To make 'em go round and round,
Just be careful in your findings
And be sure of what you've found.

The peripheral speed of tire
And the air speed of the plane
You may find so di-a-vergent
It sometimes gives you pain.

Then this subject of the methods:
They are sure to carry weight.
So take one look into this phase
Before it's far too late.

Now the cost of application
Must finally be checked
Just to have your pre-rotation:
It all fascinates, by heck!

—W. H. ELLIOTT

Aircraft Engine

The first speaker took fellow engineers into his confidence as he outlined the development of an aircraft-engine design, showing why compromises must be expected. An important contribution to the literature on cooling aircooled engines was made by the second speaker. So interested were the engineers in the capacity audience that groups of them lingered in technical discussion for more than two hours after the session was closed by Norman Nevil Tilley, chairman. More than two score left the ballroom only when hotel housemen began to ready the place for the evening session which began at eight with Dr. Igor Sikorsky the speaker.

Commercial Pressures On Engine Designers Lead to Compromises

By CARL T. DOMAN, Aircooled Motors Corp.

IN DESIGNING a new aircraft engine, the engineer would prefer to have a definite objective with respect to specific output, total weight and production costs. But the sales department never lets him operate this way. As soon as an engine is on paper, the sales department toys with the idea of selling the engine for a different power range. Hence the engineer provides enough space between cylinder centers so when the pressure comes for more power he can get busy with the reamer and enlarge the bore.

The sales volume of an engine in lower horsepowers has not reached a point where an engine can be designed for a specific speed and output. Management is faced with the problem of taking an engine with a given bore and stroke and operating it at different speeds or with different compression ratios, and thus be in a position to offer a range of power which would meet the demands of various airplane manufacturers.

It is safe to assume that the engineer never pictures actually what the given design may be eventually asked to do. What is the engineer's problem in arriving at a design from the basic selection of bore, stroke, number of cylinders, valve size, etc., as related to the induction system itself? In a series of horizontally opposed aircooled engines having a basic cylinder size of 4¼ in. bore and 3½ in. stroke, an engineer might consider these characteristics:

Width of the engine not to exceed 30½ in.

Ultimate delivery, 27 to 33.5 hp per cyl at 3500 to 4000 rpm and 16.2 to 30 hp at 2000 to 3300 rpm,

It must not exceed a weight of 245 lb for the 4-cyl engine and 322 lb for the 6-cyl unit, completely equipped with magnetos, starter and generator, and

Selection of the materials used would be based on the minimum cost with maximum durability or life.

The original study of the cylinder was on a basis of 4 in. diameter. Stroke and the valve sizes varied to obtain the maximum size of inlet valve without decidedly restricting the exhaust valve and at the same time provide a practical and safe bridge in the cylinder head between the two valves. Cylinder centers selected would permit the bore to be increased to 4¼ in. when the sales pressure would be exerted.

The inlet valve has 62% greater area than the exhaust valve. Experience shows that no increase in output has resulted in this cylinder by enlarging the exhaust valve up to ⅛ in. in diameter. But increase of the inlet valve size has shown an appreciable increase in power. The inlet valve could not be safely increased in diameter due to the decrease in bridge width between the valves.

By changing the tooling it would be possible to spread the centers of the valves on the larger bore cylinder and thus obtain larger valve diameters. But the design is compromised in order to permit the cylinders to go through the same machining fixtures as used on the 4-in. bore cylinder.

The primary reason for the larger bore and short stroke was to provide valves of sufficient size so that the engine would breathe well at the higher speeds. One decided disadvantage of the short stroke engine is the fact that the crankshaft is heavier, because it isn't possible to use as large lightening holes as in a longer stroke engine.

When the basic cylinders were still on the drafting board, and the size of the cylinder had been determined, considerable time was spent attempting to determine whether to use a conventional overhead type valve or a mechanism operated through the use of a hydraulic valve lifter. Experience gained in building several thousand aircooled automobile engines proved it was possible to design an overhead valve mechanism where the change in clearance at the inlet or exhaust valve would not be more than 0.003 hot to cold on either valve.

In general a larger diameter in the barrel of the camshaft with a large lightening hole gives best results, but an engine is only a compromise, and maximum camshaft size can only be selected within certain limits.

Mount Carburetor Under Engine

Because aircraft engines in the lower horsepower bracket are all of the horizontally opposed type, it is usual practice, for simplicity and for cost purposes, to mount the carburetor underneath the engine. There are several objections to the carburetor on the oil pan.

A so-called "runner" type of manifold was developed and is satisfactory up to 3500 rpm. With this general manifold arrangement on both the 4- and 6-cyl engines, two carburetors are used. But in developing this type of manifold, poor peak power resulted; it was found that by the use of a front balance pipe, the shape of the power curve was entirely altered.

In actual flight conditions in a relatively fast plane, with a constant-pitch wooden propeller, it has been found that without the front balance pipe, the climb is much better, whereas at full-out level flight, speed is sacrificed. Another advantage with this manifold with the carburetors located alongside the rear cylinders, is the possibility for mounting the engine in the wing.

On 6-cyl engines the power output with a single carburetor for speeds above 3000 rpm has never approached that with dual carburetors.

In an experimental group of engines, all with the same cylinder, the output per cyl in the 6, 8- and 12-cyl models, is approximately the same at the rated speed of 3200 rpm, indicating a uniformity in the induction system, even though the firing intervals between successive cylinders might not be as desired.

The 2-cyl engine operating at 3500 to 4000 rpm would be smooth for a light airplane, provided the engine is properly installed on the airplane mount with properly designed rubber bushings.

(Digest of "Intake Systems for Aircraft Engines.")

Tests Confirm Value Of Aluminum Finning On Aircooled Engines

By MARCEL PIRY,
Ranger Aircraft Engines
Division of Fairchild Engine
& Airplane Corp.

RATES of heat evacuated from cylinders to maintain the temperature of mechanical parts within normal operating values, has increased almost in direct proportion to the engine output. Aircooled engines have aluminum cylinder heads to achieve smaller weight and better cooling. Cylinder barrels with steel fins are no longer capable of meeting the requirement of heat rejection necessary to maintain the pistons and the cylinder walls within operating limits. Hence, a process has been developed to provide a steel barrel with an integrally-bonded aluminum muff in which fins are machined by a normal machining operation.

Both aircooled engines, radial and in-line type, would cool considerably better if more cooling capacity existed at the levels of the piston dead centers. Little cooling occurs at top dead center, where the piston is stopped and receives its maximum heat in-put, because of the poor heat transfer across the threads or the shrink band, and practically no cooling exists at the level of the flange because of the lack of fins in that region.

It is interesting to point out the main differences existing between the cooling problems of both radial and in-line aircooled engines.

In the in-line engine the piston thrust and antithrust are applied on the cylinder wall parallel to rather than perpendicular to the direction of the air flow. These parts of the cylinder wall therefore receive the most heat. Hence baffles adequate for the cooling of the in-line engine are very different from those adequate for the cooling of the radial engine. On a radial engine, maximum cooling must be obtained in front and back of the barrel. With a conventional type of baffle the downstream side (back) of the cylinder must be cooled with the same air that was used to cool the upstream side (front).

This difficulty, however, can be overcome with the proper type of fins and baffles, and it is fortunately partly compensated by the fact that considerably less cooling is required on the sides of the cylinders where the fin width can be decreased to augment the engine air conductivity. In-line engine baffles may or may not be required on the upstream side depending on whether the piston thrust or antithrust is applied on the front of the barrel. In a V-type aircooled engine, one bank has the piston thrust applied on the front of the barrel (inside the V, upstream) the other bank has the piston thrust applied on the back of the barrel (outside the V, downstream).

In order to take full advantage of the small cross-sectional area of the in-line engine, it is necessary to provide it with a small cooling air scoop.

(Digest of "Cooling Characteristics of Steel and Aluminum Finned Cylinders for In-Line Aircooled Engines.")

DISCUSSION

(Papers by Messrs. Doman and Piry)

Both authors were subjected to a barrage of questions on the details of their results and how they obtained them.

Mr. Doman's discussion on blowback interested W. H. Moore, Ranger Aircraft Engines. The author explained further that the 2-cyl engine had excessive blowback in the speed range of 2500 to 2700 rpm.

The effect of spark-plug location on power, as shown in Fig. 15, was questioned by R. B. Lewis, Wright Aeronautical Corp. The curves in this figure should have stopped at 3200 rpm, Mr. Doman answered. The location of the plugs diagonally opposite, which gives the best efficiency, is a quite normal place for them, he said. When plugs are located on the top of the cylinder for easier accessibility, a decrease in combustion efficiency of 4.2% results, as compared with when the plugs are located diagonally opposite.

In response to a question concerning fuel injection studies, Mr. Doman said that was the only test he had carried out with a fuel injection system, and the same power had been obtained as when a carburetor was used.

How Mr. Piry measured a drop in temperature on the engine between aluminum and steel puzzled a number in the audience. Mr. Piry explained that he used two thermocouples ½ in. apart. One pin is embedded in the steel and the other in the aluminum. The pin in the aluminum is placed only about 0.050 to 0.060 in. farther out radially from the center of the cylinder than the pin in the steel sleeve. Tests showed that this set-up accounted for about a 2 deg difference in temperature.

Explains Tests

Mr. Piry went on to explain tests made with a ring consisting of two semicircular pieces of steel and aluminum bonded together. These showed that the rate of change of temperature drop from the steel to the aluminum is sufficiently small to be neglected.

Chairman Tilley thought that so many thermocouples placed at various points on the fins of the cylinders would have an appreciable effect on the drop in static pressure being measured. Agreeing with him, Mr. Piry admitted that for this very reason, the number of thermocouples had been reduced to a minimum and the thinnest wire possible had been used in obtaining the measurements. The error appears to be about 3%. When making comparisons between cylinders, special care must be taken to use the same size of wire and number of thermocouples. Some effect seems inescapable because some sort of an instrument must be used to measure the temperatures.

HOWARD C. MARMON, president of the SAE in 1913 and a life member of the Society, died April 4, 1943, at Fort Lauderdale, Fla., aged 66.

Mr. Marmon had lived on his 5000-acre estate at Pineola, N. C., since 1923. After Nordyke & Marmon Co., Indianapolis, Ind. – of which he had been vice-president and chief engineer for 25 years – went out of business in 1936, Mr. Marmon devoted his time to developing on his estate one of the world's largest evergreen tree nurseries, and to his interests in mining and milling operations yielding kaolin, feldspar, and mica. It was his custom to spend winters in Florida.

Howard Marmon is credited with development of the first side-entrance automobile body, the first engine with hollow crankshaft carrying oil direct to bearings, and the first all-aluminum car. He contributed to the engineering development of vacuum control of engine oil pressure, double cross rear spring suspension, and 12- and 16-cyl engines.

His automotive career began in December, 1902, with the design and construction of an automobile to replace a purchased car which failed to satisfy his requirements. In 1903 he built a second model to incorporate desirable improvements, and in 1904 built six more. In 1906 a Marmon car won the Glidden Tour, creating a demand which put the Nordyke & Marmon Co., manufacturers of flour mill machinery since 1866, into the automobile business. In 1911 the Marmon "Wasp" won the 500-mile Memorial Day race at Indianapolis, leading to further expansion of plant and output.

For years, Howard Marmon developed experimental cars, incorporating what then were regarded as radical designs, but which time proved were sound engineering. Until ill health forced him to abandon the project, Mr. Marmon was developing a "whaleback" design which unitized body and chassis.

Mr. Marmon's engineering achievements and his personal popularity were recognized by his election as SAE president in 1913 – three years after he had become a member – and his election the same year as the only American honorary member of the British Institute of Automobile Engineers.

He served in World War I as Army Air Corps captain in charge of the aircraft engine experimental station at McCook Field, Dayton, and made engineering contributions to the development of the famous "Liberty" aircraft engine. He received an honorable discharge from the U. S. Army at the end of the war as lieutenant-colonel.

Mr. Marmon was born at Richmond, Ind., May 24, 1876, the son of Daniel W. and Elizabeth C. Marmon. He was educated in the schools of Indianapolis, Earlham College, and University of California. He entered the employ of Nordyke & Marmon in 1899 and became vice-president and chief engineer in 1909 upon the death of his father and the election of his brother, the late Walter C. Marmon, as president.

Surviving are the widow, Mrs. Martha Foster Marmon; a daughter, Mrs. Nicholas Tchokotua, of Mexico City, Mexico; a sister, Mrs. James W. Fesler, of Indianapolis; and four grandchildren.

Howard C. Marmon

(1876-1943)

About SAE

SAE Buffalo Section Chairman **PETER F. ROSSMANN** heads the new development division of the Curtiss-Wright Corp. Mr. Rossmann has been chief of development research in the laboratories of the airplane division. The new division will collaborate on engineering problems relating to the airplane, engine and propeller divisions of Curtiss-Wright, and will anticipate the development of new products for post-war markets.

R. K. McCONKEY, formerly with the Timken Bearing Co., Milwaukee, is now district manager of the Los Angeles office of Timken.

YUKIO KONO, who had been head mechanic of the Minidoka W.R.A., 15-1-C-Hunt Branch, Twin Falls, Idaho, is now specializing in motor tune, and carburetion servicing of electrical equipment at Rasmussen & Thompson Co., Ogden, Utah.

Formerly leadman, carburetor Test Laboratory, Wright Aeronautical Corp., Paterson, N. J., **F. A. PETERS** is now foreman of the Carburetor Test Laboratory.

E. J. TANNER has recently been transferred to the Wind Tunnel Group in the Martin Aerodynamics Department. In the near future, Mr. Tanner expects to be helping with tests at the MIT Wind Tunnel.

LT. LAWRENCE WILLIAM HEM is in the U. S. Army Air Forces, War Department, Headquarters Material Command, AAF, Washington. Lt. Hem was promoted from second lieutenant and transferred from Air Service Command, Air Depot Detachment, Hamilton, Tex.

CARLETON E. STRYKER is chief of the Conservation and Standards Division, Resources Control Office, Aircraft Production Board.

ADDISON M. ROTHROCK, who had been head of the Fuels and Lubricants Section of the National Advisory Committee for Aeronautics, Hampton, Va., is now chief of the NACA's Fuels and Lubricants Division, Aircraft Engine Research Laboratory, Cleveland.

LT. (jg) PIERRE S. de BEAUMONT, USNR, is in the Navy department of the Bureau of Aeronautics, Manufacturing Operations Section, Washington. Lt. de Beaumont is assisting **LT.-COM. D. W. RANDOLPH** on the production aspects of aircraft design changes.

LT. DONALD McALLISTER has been transferred from Fort Levett, Portland, Me., and has been assigned to the Army Specialized Training Program at the Massachusetts Institute of Technology, Cambridge.

Major - Gen. Stephen G. Henry, who commands the new 20th Armored Division at Camp Campbell, Ky.

MAJOR-GEN. STEPHEN G. HENRY, former commandant of the Armored Force School, Fort Knox, Ky., has been assigned to command the new 20th Armored Division, Camp Campbell, Ky. His promotion from brigadier general followed his new assignment by a few days. Gen. Henry became an SAE member 14 years ago. He served during the Mexican crisis as a second lieutenant, completed his work at Louisiana State University and was graduated a bachelor of science in 1917, was commissioned a first lieutenant that year, and became a major in 1918, when only 23. He conceived, built, and expanded the huge Armored Force School which he described at the SAE War Engineering Production Meeting on Jan. 11 in Detroit. (*SAE Journal*, March, 1943, p. 17.)

On temporary leave from the Aircraft Engine Research Laboratory, National Advisory Committee for Aeronautics, Cleveland, **ENSIGN MICHAEL B. COMBERIATE,** USNR, is at the Naval Training School (aeronautical engineering), California Institute of Technology, Pasadena, Calif.

Adel Precision Products Corp., Burbank, Calif., was named one of the prize winners in the annual All-America packaging competition sponsored by *Modern Packaging Magazine*. **GEORGE THARRATT,** Adel's chief engineer, designed the winning entry—a set of special cellophane bags used to package the company's replacement and extra parts for aircraft anti-icing and hydraulic systems. In making the award, judges considered the necessity for protecting such small metal parts for war use.

George Tharratt, designer of cellophane bags which won All-America packaging award

Members . . .

A. V. **HOWE** and **A. R. LEUKHARDT** have been named director of defense activities and manager of manufacturers' sales, respectively, Bendix-Westinghouse Automotive Air Brake Co., Elyria, Ohio. Both men will make their headquarters at the company's general offices and factory at Elyria, Ohio, although their duties will carry them into a broad field of operations.

Formerly with Wallace Tool & Die Co., Indianapolis, Ind., as chief tool designer, **ROBERT E. EVANS** has joined Carl L. Norden, Inc., New York City, as tool director.

SAMUEL J. WAKSHULL, formerly a student at the University of Wisconsin, has entered military service. He is in Company B, 101st Engineer Combat Battalion, Fort Jackson, S. C.

PROF. F. J. LINSENMEYER has resigned as director of mechanical engineering at the University of Detroit after 17 years on the faculty. During this period he has engaged in engineering consulting work for many industries, particularly in the automotive and heat transfer field. His new position is that of factory manager and chief engineer with the National Stamping Co., Detroit.

Prof. F. J. Linsenmeyer

First general officer in history to command the Holabird Ordnance Depot, Baltimore, is **BRIG.-GEN. HERBERT J. LAWES,** U. S. Army. Gen. Lawes' appointment became effective on April 2, 1943. Effective April 1, 1943, he assumed command of the Letterkenny Ordnance Depot, Chambersburg, Pa., with additional duty as commanding general of the Holabird Ordnance Depot. Gen. Lawes was commissioned a second lieutenant in the Infantry in 1912, and served before World War I as a lieutenant of Infantry on the Texas border. In 1917 he was mobilized with his regiment and afterward sent to duty in the Officers' Training Camps at Plattsburg. Early in 1918 he was detailed to the Motor Transport Service under the Quartermaster Corps and finished the war on that type of work as a motor transport officer, Port of Embarkation, New York City.

March 13, 1943, marked the 30th anniversary of the employment of **J. F. WINCHESTER,** manager of the general automotive division of the Standard Oil Co. (N. J.) by that company. It found him busily engaged with his company duties as a consultant to the Office of Defense Transportation, and on the verge of spending his annual vacation at Fort Leavenworth, Kan., on temporary army duty attending the 4th Army Orientation Course being conducted by the Command and General Staff School. A former member of SAE Council, and one-time chairman of the Metropolitan Section, Mr. Winchester has been active in national and local SAE work. He joined the Society 33 years ago.

A. V. Howe

A. R. Leukhardt

VINCENT BENDIX, former president of the SAE and pioneer automotive and aeronautical design and manufacturing executive, is chairman of the Langley Aviation Corp., New York, organized in 1940 to develop molded plastic plywood processes, design and construction methods for mass production of aircraft and parts. He has contributed several important patents to the methods since joining the organization a year ago.

COM. CLARENCE E. EKSTROM, U. S. Navy, assembly and repair officer of the Naval Air Station, received his detachment orders and left recently for important duty with the Fleet. Before his assignment as assembly and repair officer Com. Ekstrom served as commanding officer of Squadron 18-B, which he had organized after reporting aboard the NAS in August, 1941.

HERBERT V. DWIGHT of the B. F. Goodrich Co., Akron, Ohio, who has been sales engineer, has been named field test engineer.

CHARLES S. McCANN's new position is that of director of research, Walker Mfg. Co., Racine, Wis. Before joining the Walker company, Mr. McCann was assistant supervisor of engine testing, Aviation Engine

Brig.-Gen. Herbert J. Lawes

Promoted to Lieutenant Colonel

Heads Motor Maintenance School, Quartermaster Replacement Training Center, Fort Francis E. Warren, Wyo.

LEE M. CORLESS has been promoted from major to the rank of lieutenant colonel, and has been named head of the Motor Maintenance School at the Quartermaster Replacement Training Center, Fort Francis E. Warren, Wyo. Before his promotion he served as superintendent of one of the school shops, was assistant to the chief of the school and later served as a supervisor of motor maintenance and motor operations training. Prior to entering the service, Col. Corless had been associated with General Motors for 11 years.

Plant, Buick Motor Division, General Motors Corp., Melrose Park, Ill.

Pilot Officer **H. M. GOODE,** RCAF, formerly with the 10th S.F.T.S., Dauphin, Man., Canada, is now in the 17th S.F.T.S at Souris, Man.

LT.-COL. OTTO LESSING, USMC, is now at Headquarters, FMF, Training Center, Camp Pendleton, Oceanside, Calif. He was promoted from the rank of major, and transferred from the Engineer Battalion, FMF Training Center, Camp Elliott, San Diego, Calif.

R. G. BRADLEY has joined the General Tire & Rubber Co., Detroit, as sales manager of the Silent Block Division.

Formation of the industrial design and engineering firm of John Tjaarda & Associates, Inc., with offices in the Fisher Building, Detroit, was recently announced. **JOHN TJAARDA,** former design and research chief of the Briggs Mfg. Co. for a decade, said that the new firm is set up to specialize in post-war design and engineering, and is already working on commissions and contracts.

LT. LEE G. SNYDER, USNR, is electrical, radio, and radar officer, Office of Inspector of Naval Aircraft, Douglas Aircraft Co., Inc., El Segundo, Calif. Lt. Snyder had previously been in the Radio and Electrical Section of the U. S. Navy Bureau of Aeronautics, Washington.

COL. JOHN H. JOUETT, executive vice-president of Higgins Aircraft, Inc., has been made president of the Bellanca Aircraft Corp. **G. M. BELLANCA,** founder of the firm, was elected chairman of the board, and **L. C. MILBURN** continues as executive vice-president and general manager.

JOHN L. KEESHIN, president of the Keeshin Freight Lines, Inc., Chicago, has been appointed a member of the Common Motor Carrier Advisory Committee by the Office of Price Administration to advise that agency on rates and ration problems.

C. G. KRIEGER, who has been acting director of the Farm Machinery and Equipment Division of WPB, has been made director. Mr. Krieger is on leave of absence from the Ethyl Corp.

Two additional members of the SAE Tractor War Emergency Committee, **D. C. HEITSHU,** Harry Ferguson, Inc., and **D. A. MILLIGAN,** Cleveland Tractor Co., are now serving as consultants for the Farm Machinery & Equipment Division, War Production Board.

FRED L. HALL, who had been director of defense activities and distribution, Bendix-Westinghouse Automotive Air Brake Co., Elyria, Ohio, is now located in New York City as vice-president in charge of sales of the Rogers Diesel & Aircraft Corp.

RICHARD H. BANCROFT of The Perfect Circle Co., New Castle, Ind., has been promoted from metallurgist to plant manager.

GUY E. FINOUT, JR. has left the Carribean area, and is now at the Army Ordnance, Aberdeen Proving Ground, Maryland, for officer training. He has been a sergeant.

LEONARD A. COLSTON, who for three years has been a designer at North American Aviation, Inc., Inglewood, is now contract engineer with Lockheed Overseas Corp., and is stationed at a foreign base.

Leonard A. Colston

LT. ROBERT J. WHITLEY is with the Maintenance Branch, Preventive Maintenance Section, Tank-Automotive Center, Detroit. He was formerly in the Field Service Division, Preventive Maintenance Section, Arlington, Va.

EARL W. HAEFNER, U. S. Army, has been promoted from captain to major. He is commanding officer of the Fort Crook Ordnance Automotive School Detachment. He had been motor maintenance officer in charge of the Motor Base Shop.

MAJOR JOHN G. MAC'KIE was promoted from captain, U. S. Army, Infantry Airborne Command, Parachute School, Fort Benning, Ga.

S. J. CHENEY, formerly of Wayne University, is now with the General Motors Corp. in the Product Study Group as design engineer. For a short time after leaving Wayne, Mr. Cheney was employed at Packard.

Formerly assistant plant manager, Pioneer Paper Stock Co., Division of Container Corp. of America, Chicago, **LLOYD E. WILLIAMS** is now a second lieutenant, U. S. Army, stationed at the University of Wisconsin, Madison.

J. GODFREY BORGER is with Pan-American Airways, Inc., New York City. Formerly Mr. Borger was assistant resident engineer, Lockheed Aircraft Corp., and Pan-American Airways, Inc., Burbank, Calif.

T. C. SMITH, American Telephone & Telegraph Co., served as SAE representative on the Convention Advisory Committee for the 14th Annual Convention of the Greater New York Safety Council held in New York City, March 23 to 25. Mr. Smith is also SAE representative of the Committee on Definitions of the National Conference on Uniform Traffic Accident Statistics which has just issued a 17- page booklet on "Uniform Definitions of Motor Vehicle Accidenst." Other SAE members on the committee are **DAVE M. BALDWIN,** representing the American Association of Motor Vehicle Administrators, and **CHARLES G. MORGAN, JR.,** American Trucking Association, Inc. The purpose of the standard definitions is to obtain comparable traffic accident data. Single copies are available free from Director J. C. Capt, Bureau of the Census, Washington.

2ND LT. JULIUS FRANK KOETSCH is a fighter pilot and assistant engineering officer in the U. S. Marine Corps Reserve, and can be reached in care of the Fleet Post Office, San Francisco. He had previously been stationed at Miami, Fla.

COL. MARK V. BRUNSON, Quartermaster Corps, U. S. Army, is stationed at Headquarters, Motor Transport Service, Iran, Persia. He can be reached through A.P.O. 523, New York City.

Formerly in the Experimental Engineering Section, Materiel Center, Wright Field, Dayton, Ohio, **2ND LT. GERALD JOSEPH McCAUL** has been transferred to the Materiel Center, Flight Test Base at Muroc, Calif.

R. J. CORY, who had been sales engineer of the Wico Electric Co., with offices in Chicago, has returned to Springfield, Mass., and is now general purchasing agent.

JOHN L. COLLYER, president of The B. F. Goodrich Co., has been named a member of the National Industrial Information Committee governing board.

Formerly manager of the Gun Turret Division, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., **W. B. PAINE** has been transferred to general manager of the Owosso (Mich.) Division of the company.

GERVASE M. MAGRUM, assistant chief engineer, Houde Engineering Corp., Buffalo, and 1940-41 chairman of the SAE Buffalo Section, spoke before a recent Buffalo Section meeting of the American Society of Mechanical Engineers on the subject of "Tricycle Landing Gears."

NOEL JOHN NICASSIO, formerly assistant supply manager in charge of automotive and engineering purchasing, R. H. Macy & Co., Inc., New York City, is now connected with the Burndy Engineering Co., Inc., New York City, as a mechanical engineer.

VALENTINE GEPHART, lieutenant colonel, U. S. Marine Corps (Res.), and a member of the Northwest Section of the SAE for 17 years, is now in California. Col. Gephart left the Naval Air Station at Pasco, Wash., several months ago and reported for duty with Air Base Group Two of the

Lt.-Col. Valentine Gephart

Marines at San Diego. While in Pasco, Col. Gephart served as assembly and repair officer of that base. He reported to Air Base Group Two for duty as executive officer and was given command of the group on March 8. This group is an engineering organization, consisting of five engineering squadrons of marines.

LT. DANA M. DAWES, who had been research assistant in the cutting oils department of The Pure Oil Co., Chicago, is now a second lieutenant in the U. S. Army, and is stationed at the Chicago Quartermaster Depot.

ENSIGN K. E. MONTAGUE, USNR, is an inspector of naval aircraft, Douglas Aircraft Co., Inc., El Segundo (Calif.) plant. He had been aeronautic specialist, U. S. Navy, at Beaumont, Tex.

C. LYLE DAVIS has been transferred from manager of the Minneapolis-St. Paul Operations of the Macmillan Petroleum Corp. to division manager in charge of the Chicago District and office.

H. P. SCHADE, vice-president in charge of sales, Arrow Safety Device Co., Medford, N. J., has just announced expansion of the war facilities of his organization, which will include the erection of an entirely new plant at Mount Holly, N. J.

WILLIAM L. BATT, vice-chairman of the War Production Board and president of SKF Industries, Inc., Philadelphia, has been awarded the Bok Award – a medal and a $10,000 check for his service to the nation in leading industrial mobilization for winning the war and as a citizen who performed the most distinguished service for Philadelphia in 1942. This award is the 21st since its inception by the late Edward W. Bok in 1921.

Formerly assistant instructor, U. S. Army Air Forces Technical School, Chanute Field, Ill., **HOWARD A. WESTERBERG** is now an aviation engineering cadet, stationed at Boca Raton Field, Fla.

E. H. ROSSELL is now a student in the Royal Canadian Air Force School of Aeronautical Engineering. He had been engine inspector, RCAF, No. 3 Repair Depot, Vancouver, B. C., Canada.

MILES E. JOHNSON has left the Continental Aviation and Engineering Corp. in Muskegon, where he was division engineer, to accept a position as engineer for Draper Motors, Detroit.

HARRY KOTTAS, who had been associate mechanical engineer, National Advisory Committee for Aeronautics, Hampton, Va., has been transferred to the NACA's Aircraft-Engine Research Laboratory in Cleveland, where he is mechanical engineer.

MAJOR PAUL G. HYKES has been transferred from the 33rd Coast Artillery Brigade, San Diego, to Headquarters 55th Coast Artillery Brigade, Camp Stewart, Ga.

Formerly service manager of the Harcourt Motor Co., Newburgh, N. Y., **MILTON C. GILBERT** has joined the Scintilla Magneto Division, Bendix Aviation Corp., Sidney, N. Y.

BENJAMIN B. CRAVENS has joined Faber Laboratories, Inc., New York City, as service engineer. Formerly Mr. Cravens was superintendent of maintenance, W. T. Cowan, Inc., Baltimore, Md.

J. S. BEECHLER, who had been field engineer and expediter for Ranco, Inc., Columbus, Ohio, is now with Firestone Steel Products Co., Akron, Ohio.

Formerly an instructor at the Wendell Phillips High School, Chicago, **NORMAN EDWARD CARLSON** is now a lieutenant (jg), USNR, stationed at the Landing Force Equipment Depot, Newton Park, Norfolk, Va. He has been assigned to duties in the installation and maintenance of the powerplants of landing craft.

CAPT. H. R. GOODBODY is in the 20th Armored Division at Camp Campbell, Ky. He had been national accounts service representative, Studebaker Corp., New York City.

Southern Ohio Section Secretary **C. R. TALMAGE** has changed his position from sales engineer of the Moraine Products Division, General Motors Corp., Dayton, to the A. Robert Snyder Co. He is doing mechanical engineering work on various aircraft applications.

COL. WILLIAM B. JOHNSON, Ordnance Department, has been transferred from the Holabird Motor Base to the Proving Center, Aberdeen Proving Ground, Md.

Formerly a student at the Aeronautical Industries Technical Institute, Los Angeles, **H. G. HAMBLETON** is now a member of the air force of the Free French Forces.

ELMER J. BRYANT, who had been Chicago district manager of the Greenfield Tap & Die Corp., Greenfield, Mass., is now chief engineer of the Gage Division.

HOWARD L. WILLETT, JR., is back at The Willett Co., Chicago, from his duties as chief automotive adviser in the U. S. Army, 94th Division, Camp Phillips, Salina, Kan.

Peter Altman

PETER ALTMAN, for the past two and a half years director of the Manufacturing Research Department of Vultee Aircraft, Inc., has resigned to form a consulting and development service with offices in Detroit. Prior to organizing the Manufacturing Research Department for Vultee, Mr. Altman, SAE past vice-president representing the Aircraft Activity, was director of the Aeronautics Department at the University of Detroit. He held this position for 15 years, during which time, in addition to the University work, he engaged in consulting and development work on many projects.

The Automotive Council for War Production's managing director, **GEORGE W. ROMNEY,** spoke before a meeting under the auspices of the Michigan Engineering Society and The Engineering Society of Detroit. Mr. Romney's talk was titled "Detroit – An Arsenal of Democracy."

LT.-COM. D. W. RANDOLPH, USNR, is with the Production Branch, Bureau of Aeronautics, Washington. Before being commissioned Com. Randolph had been with the Packard Motor Car Co.

Lt.-Com. D. W. Randolph

SAMUEL P. BILLINGS, JR., has left the Department of Water & Power, City of Los Angeles, where he was supervisor of equipment operations, and is with the Pacific Crane & Rigging Co.

CAPT. CHARLES MOHNEN, Army Air Forces, is attending officers training school at Miami Beach, Fla.

Formerly product planner at the Bromley Engineering Co., Detroit, **FRANCIS H.**

CATALDO has left this company to become contract estimator at North American Aviation, Inc., Inglewood, Calif.

For the past seven years field representative for the Monmouth Products Co., **WALTER I. BUCHANAN** has been promoted to the position of chief service manager for the company and hereafter will be located at the company's main office in Cleveland. Mr.

Walter I. Buchanan

Buchanan's former work consisted largely of service to the National Automotive Parts Association warehouses and jobbers, and for the last six months he has been stationed in Detroit, working with the Motor Transport Division of the Quartermaster Corps, in connection with problems of maintenance of automotive equipment.

Formerly a student at the Lawrence Institute of Technology, **JOSEPH E. KENNEDY** is now a private in the U. S. Army, and is stationed at the University of Michigan, Ann Arbor.

MAJOR RAY H. BRUNDIGE, formerly 3rd Army Headquarters, San Antonio, Tex., is now on foreign service.

LT. (jg) RICHARD F. CORWIN, USNR, who had been an ensign in the Navy Department, Aeronautical Board, Washington, has been assigned to Headquarters Squadron 16, Fleet Air Wing 16, and can be reached in care of the Fleet Postmaster, New York, N. Y.

DON EARL CAMPBELL, formerly at Texas A & M College, is in the U. S. Army. He is an officer candidate, and is stationed in the 18th Battery, 1st Platoon, at Camp Davis, N. C.

J. L. LITTLETON has severed his connections as senior industrial engineer and manager of the Contract Distribution Department of the WPB in Cleveland, and is now connected with the Cleveland office of Lear Avia, Inc., of Piqua, Ohio, as manager.

In the February issue of the *SAE Journal* (p. 55) we published a picture of the American Mission of Aviation Manufacturers to England. We erroneously identified one of the members as Major Thomas Hitchcock rather than Lt.-Col. Eric T. Bradley, who was the actual U. S. Army Air Forces officer delegated to act as guide to this Mission.

EARLE F. TRAISE is production manager of the Aircraft Division of the Wilkening Mfg. Co., Scranton, Pa. Mr. Traise had been in the industrial and equipment sales department of the Philadelphia office of the company.

LT.-COL. WILLIAM H. FISHER, formerly a major, and who had been assistant regiment executive officer and automotive school director, has been made director of the 27th Battalion Automotive School. Col. Fisher is stationed at Camp Croft, S. C.

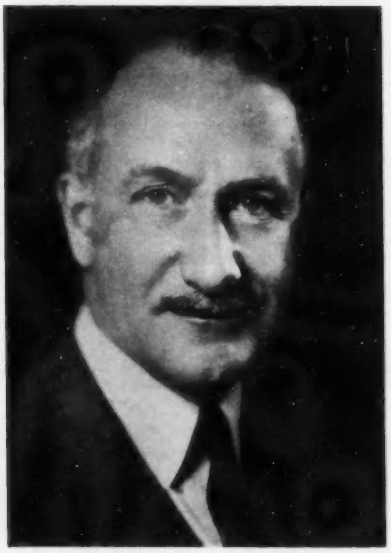
Promotion of **B. H. SIBLEY,** Champion Spark Plug Co., Toledo, Ohio, from chief engineer to factory manager, recently took place.

CAPT. JOHN ST. HORNOW has been transferred from the Corps of Engineers, Camp Claiborne, La., to the Ordnance Department at Fort Ord, Calif. He is assigned to the command of the fourth echelon shop.

GILES E. HOPKINS, who had been technical director of the Research and Development Department, U. S. Asbestos Division, Raybestos-Manhattan, Inc., Manheim, Pa., is now chief of the Service Division, Board of Economic Warfare, Washington.

At a recent meeting of the stockholders of the Formica Insulation Co., Cincinnati, **R. W. LYTLE** was elected vice-president. Mr. Lytle has been a member of the SAE since 1923.

SKF Industries, Inc., Philadelphia, announces the election of **RICHARD H. DeMOTT** to vice-president in charge of sales. Mr. DeMott had been general sales manager.



Richard H. DeMott

G. ALLEN CREIGHTON is leaving the Electric Boat Co., New London Ship & Engine Works, where he was assistant to the chief engineer, to join the Lycoming Division, The Aviation Corp., Williamsport, Pa., as assistant experimental engineer.

ERNEST R. STERNBERG has joined the Sterling Motor Truck Co., Inc., Milwaukee, as director of materials. Mr. Sternberg was formerly assistant chief of the War Agencies Section, Automotive Branch, WPB, Washington.

E. F. BRUNNER, of the Goodyear Tire & Rubber Co., Akron, Ohio, is a consultant in the Office of the Rubber Director.

JOHN J. POWELSON is one of the editors of the revised, 1943 edition of The Motor Truck Red Book, an encyclopedia of the laws, rules, regulations, principles and practices of motor truck transportation. It is published by the Traffic Publishing Co., Inc., New York City. Mr. Powelson is in the motor vehicle department of the Standard Oil Co. of N. J.

W. H. BOSHOFF, has been promoted from captain to major. Major Boshoff is in the Ordnance Department of the U. S. Army, and is stationed at Fort Bragg, N. C.

JOHN J. PUNKE, formerly development engineer of the Precision Castings Co., Inc.,

John J. Punke

has been named factories manager of plants in Syracuse, Fayetteville, N. Y., and Cleveland.

A general chemical treatise on the subject of petroleum, its properties, refining, and utilization has recently been published by **WILLIAM A. GRUSE** and D. R. Stevens, of the Mellon Institute of Industrial Research.

The new volume, entitled "Chemical Technology of Petroleum," is the complete revision of a much smaller book published by Mr. Gruse in 1928.

The application of chemistry to petroleum production problems, cracking, and the chemical thermodynamics of petroleum hydrocarbons are given complete and up-to-date treatment. Motor fuels, lubrication and lubricants, paraffin, asphalt, as well as many other petroleum products and by-products are covered in a comprehensive manner.

The book's 733 pages include many tables and charts, and an appendix of the physical properties of the principal hydrocarbons that gives such data as refractive index, octane number, critical solution temperature in aniline, and the critical temperature, pressure, and density. McGraw-Hill is the publisher.

OBITUARY

John F. Young

John F. Young, supervisor of plane maintenance and master mechanic of the flight division in charge of flight tests at the Willow Run bomber plant, died recently at the age of 46. From 1928 to 1935 he was service manager of the Ford Buffalo plant, and from 1935 to 1942, when he was transferred to Willow Run, he held a similar position at the Ford plant at Long Beach, Calif. During World War I he served for 23 months in the U. S. Air Service.

★ ★ PROMOTIONS ★ ★

of special interest to SAE technical committee members have come recently to three important Ordnance officers

MAJOR-GEN. G. M. BARNES, in charge of research and engineering, Office of the Chief of Ordnance, has been promoted from the rank of Brigadier General. SAE Ordnance Advisory Committee A has had the privilege of serving Gen. Barnes on numerous occasions ever since its organization in 1920. As World War II goes forward, Gen. Barnes is utilizing extensively the assistance of the SAE War Engineering Board, SAE Ordnance Advisory Committees A and B, and other technical resources of the Society. He has been a featured speaker at a number of major SAE gatherings.

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(BELOW)

BRIG.-GEN. STEWART E. REIMEL, chief of the Maintenance Branch of the Tank-Automotive Center in Detroit, has been promoted from the rank of Colonel. The currently expanding work of the SAE Ordnance Vehicle Maintenance Committee (operating under the auspices of the SAE T&M War Advisory Committee) is concerned with several problems posed by sections directly under Gen. Reimel's command.

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(ABOVE)

BRIG.-GEN. E. E. MacMORELAND, chief of Maintenance Branch, Field Service Division, Ordnance Department, has been promoted from the rank of Colonel. At the 1940 SAE Summer Meeting, Gen. MacMoreland (then Lt.-Col. MacMoreland and a member of the Clearance Committee of the Army and Navy Munitions Board) was the chief guest speaker and participated in the informal conferences which led to establishment at that meeting of what is now the SAE War Activity Council. In his present capacity, Gen. MacMoreland reports to Major-Gen. Julian S. Hatcher, chief of the Field Service Division, Office of the Chief of Ordnance, who will be the dinner speaker at the SAE National Transportation and Maintenance Meeting in New York on May 5.

WEDNESDAY, JUNE 2

Morning — Diesel-Engine

The Control and Suppression of Diesel Engine Noise, Theory and Practice
— R. L. Leadbetter, Burgess Battery Co.

The Influence of Diesel Fuel Properties on Engine Deposits and Wear
— G. H. Cloud and A. J. Blackwood, Esso Laboratories, Standard Oil Development Co.

Afternoon — Fuels & Lubricants

Agreement of Laboratory Diesel Engine Tests with Service Performance
— R. S. Wetmiller, The Texas Co.

The Fairbanks Morse Diesel Engine As a Research Tool for Pre-Evaluation of Heavy-Duty Motor Oils
— H. L. Moir, W. J. Backoff, and N. D. Williams, The Pure Oil Co.

DINNER

Mac Short, President, SAE

Principal Speaker: Capt. Lisle F. Small, Shipbuilding Division, Bureau of Ships, Navy Department.

■

THURSDAY, JUNE 3

Morning — Fuels & Lubricants

Octanes or Cetanes after World War II
— C. M. Larson, Sinclair Refining Co.

Operation of Military Equipment with Heavy Duty Oils
— Major R. E. Jeffrey, Ordnance Department

Operation of Engines under Emergency Conditions
— Warren G. Brown, Caterpillar Tractor Co.

Afternoon — Diesel Engine

Engine Type Requirements for Military Vehicles
— Lt.-Col. Carl E. Cummings, Tank-Automotive Center

Diesel Maintenance in the Fleet
— Lt.-Com. R. J. Moore, Navy Department, Inspector of Machinery, Cleveland Diesel Engine Division, General Motors Corp.

News of the Society

continued from page 24

as members responsible representatives of both fabricators and users of springs and spring materials and the manual, therefore, represents the coordinated views of these groups.

Bulk Factor Tends to Affect Method of Plane Structure

■ *Philadelphia*

Various materials used in aircraft structures were discussed by Col. E. J. W. Ragsdale, Budd Mfg. Co., in his paper "Stainless Steel in Transportation," presented at the March 10 meeting of the Philadelphia Section. Although the title of his paper intimated a more general topic, lack of time limited his remarks to the airplane.

Initially the airplane was constructed of cloth backed up by wood, and this was followed by plywood with a wood frame. After this type of structure came the use of steel tubing and cloth covering, until finally came the all-metal plane using magnesium and aluminum. The latter two materials have been supplanted in various degrees by stainless steel. The most recent arrival is the so-called plastic plane, Col. Ragsdale reported.

Difference Lies in Bulk

He emphasized the fact that the weight strength basis of all these materials is theoretically the same as a structural medium. The difference lies in the bulk of the material. For example, he said, spruce is 18 times as bulky as is stainless steel for the same strength.

This bulk factor, he pointed out, shows up in the manufacture of the structure. For instance, if a few are to be made, the bulkier material is found to be easier to handle, but as the number produced increases, the curve tends to swing toward the less bulky materials. Wood fastened together by glue is the easiest method of fabrication for a few units, but it is hard to manage in large quantities. Aluminum has to be riveted, which is easier than gluing but requires a lot of handwork. Stainless steel with "shot welding" as the method of fastening is much the best, he said, but requires large numbers of units for economy.

Importance of Fabrication

The importance of fabrication, he continued, can be seen when you consider that the basic material may be worth 40¢ per lb and the finished airplane $20 per lb.

Although he believes stainless steel to be the best material for airplane structures, reduction in bulk lessens the stiffness of any material under compression loads, he said, thereby resulting in thin sections which require bracing. This brings about design difficulties, but these design problems have been, and continue to be, solved, he reported.

Some advantages which Col. Ragsdale said can be obtained from the use of stainless

steel in aircraft structures are as follows:

1. In case of fire, wood burns and aluminum loses its strength at about 550 F, whereas at 1200 F, stainless steel is still stronger than carbon steel at normal temperatures.
2. It has high rust-resistance, thereby reducing the maintenance problem.
3. It has over six times the fatigue strength of aluminum.
4. The impact resistance is very high regardless of its temperature.

President Short Praises Country's Shift From Peacetime Production to War Weapons

■ Oregon

"WE have never lost a war yet and we don't intend to lose this one," SAE President Mac Short declared at the Oregon Section's 12th Annual Dinner Meeting held in the Benson Hotel on March 12. "The engineering and production front has changed from a defensive position to an offensive or attack position in the past few months. It lost the battle of words on the conversion to war production; it's winning on the basis of its action. Schedules are being met or exceeded and we are settling the question of whose equipment is best."

President Short praised the voluntary and harmonious exchange of "know-how" between automotive engineers and production men as making it possible for war production to get under way.

"Touring sedans to tanks, tractors to torpedoes, seeding machines to shells, bodies to bombers – it was through one engineer or production man passing his 'know-how' on to the other that our battlefront came through and produced," he asserted.

John A. C. Warner, SAE secretary and general manager, told of some of the important contributions to the war effort by cooperation through the SAE in the field of automotive engineering.

Another SAE staff member on the program was E. F. Lowe, assistant general manager of SAE and manager of the West Coast office.

Buna-S is Government's Choice for General Uses

■ Pittsburgh

"Synthetic rubber, today, is no longer a subject only for the scientist, the economist, or the rubber man," said B. H. Weil, Gulf Research & Development Co., in a paper, "Putting the Rubber Tree in the Shade," delivered before the Pittsburgh Section on March 30.

"Faced with the problem of undreamed of rubber shortage," Mr. Weil continued, "the country awoke to find itself enmeshed in a many-sided argument among Congressmen, chemists, newspaper columnists, agricultural experts, Government officials, engineers, anti-trust prosecutors, giant corporations, small business, and just plain publicity hounds and crackpot inventors. From all these 'experts' on synthetic rubber poured a voluminous stream of contradictory facts, of claim and counterclaim, of charge and rebuttal."

Mr. Weil then told of the work of the

Left: At regular Friday noon luncheon are (left to right) J. P. Tretton, Jr., Portland Traction Co.; J. P. Bourne, Standard Oil Co. of Calif., and J. Verne Savage, City of Portland Municipal Shops & Motor Vehicle Inspection Station

Right: SAE Oregon Section Chairman Z. C. R. Hansen, right, with President Short

Army and Navy officers at Oregon Section meeting of March 12. Left to right: Major H. S. Dorman, Major William E. Evans, Lt. F. C. Wheeler, SAE President Mac Short, Com. William E. Meager, Lt. C. S. Cown, Lt. C. F. Merrifield

Baruch Committee – summoned into existence to prevent disaster – on a report capable of ending this political turmoil, of placing the rubber program on a sound technical basis, of solving the problem by replacing many bosses with one. William A. Jeffers, president of the Union Pacific Railroad, was chosen to guide the program, and he, in turn, called upon the country's best technical experts for advice, and began bringing order out of confusion, the speaker reported.

Turning aside from political economics to what *science* has been doing in the field of synthetic rubber itself, Mr. Weil said: "Despite the number of synthetic rubbers proposed, the present war has found only five types of outstanding significance, and of these only one really is equivalent to rubber in general properties and potential economics.

"These types, in order of discovery, are neoprene, Thiokol, Buna-N, Buna-S, and Butyl. Neoprene, duPont's discovery, was commercialized in 1931 on a small scale and was being rapidly developed before the war as a specialty product, although tests have shown it to be equal to rubber in almost every respect except price. Thiokol was the accidental result of experiments seeking to find a new antifreeze. It is inferior to rubber in many properties, but sufficiently superior in others to have been established on a commercial scale before the war. Buna-N, a German discovery produced in the United States under such trade names as Perbunan, Hycar OR, and Chemigum, is equivalent to rubber in many properties and superior in others. Neoprene, Thiokol and Perbunan are all outstanding in oil and chemical resistance, a property not possessed by natural rubber. Buna-S is the type which the Government has selected for the general-purpose synthetic rubber. It is said that this synthetic rubber may be substituted directly for natural rubber in over 90% of the latter's normal uses. Butyl rubber, American discovery of the Standard Oil Co. of N. J., is not yet evaluated fully, but gives promise of acceptable performance at a production cost considerably below that of the other synthetics.

"It is the belief of many experts long associated with synthetic rubber problems," Mr. Weil said, "that, given a free economy after the war, synthetic rubber will continue to pay a major role in the field of elastic materials; that synthetic rubber will not only serve democracy in wartime, but will so improve in quality and decrease in price that it will continue to replace at least a major portion of natural rubber when world peace comes again."

Tank Powerplant Problems Analyzed

Difficulty in maintenance of necessary fuel supplies is an important factor working against utilization of diesel engines in tanks, Major Howard R. Hammond, Armored Forces, U. S. Army, indicated in his talk on "Tank Powerplants" before the Milwaukee Section on April 2.

Tank operators can be trained more quickly on units equipped with the hydromatic type of drive, Major Hammond said in outlining the advantages of this type of transmission.

1943 SAE Handbook Geared to War Needs

Replete with new and revised standards, emergency specifications, and other data included to assist automotive engineers to meet wartime problems, the 1943 SAE Handbook has just come off the press and is being distributed to SAE membership, Government agencies, and military services in the United States and other countries of the United Nations. Its publication marks the 33rd annual revision of the original SAE Handbook published in 1911 and known as the "SAE Data Book."

Reflecting accurately the concentration on war production problems of the SAE Standards Committees during 1942, the 1943 Handbook features new, revised, and emergency material specifications developed to conserve critical materials and to expedite procurement.

For example, all non-ferrous specifications were gone over with a fine-tooth comb by the Non-Ferrous Division and its three subdivisions, and extensive revisions, additions, and deletions were made to bring them up to date. In addition, emergency alternate specifications have been inserted separately in the Handbook. These emergency specifications were developed in cooperation with the WPB as alternates to standard SAE specifications high in critical-material content.

Another material standard appearing in the SAE Handbook for the first time in the

Vehicle Storage Studied

The Subcommittee on Storage of Ordnance Vehicles of the SAE Ordnance Vehicle Maintenance Committee met for the first time on March 9 at Holabird Motor Base to get organized and start joint work on the project. Seated, left to right, are F. J. Ott, New Jersey Bell Telephone Co.; William H. Oldacre, D. A. Stuart Oil Co.; Lt.-Col. John M. Henderson, Office Chief of Ordnance; T. C. Smith, American Telephone & Telegraph Co., chairman; Col. Herbert J. Lawes, commandant, Holabird Motor Base, Capt. Walter H. White, Office Chief of Ordnance; Capt. C. L. Cudlipp, Holabird Motor Base, and F. V. Bott, General Motors Corp. Second row, left to right: Lt. W. A. Shepherd, Holabird Motor Base; Capt. J. E. Riley, Holabird Motor Base; A. B. Culbertson, Shell Oil Co., Inc.; Capt. E. Silver, Holabird Motor Base; Jean Y. Ray, Virginia Power and Electric Co.; H. L. Moir, The Pure Oil Co.; George A. Round, Office Chief of Ordnance; Max M. Roensch, Chrysler Corp.; F. R. Archibald and R. S. Merithew, National Carbon Co., Inc.; R. D. Evans, Goodyear Tire and Rubber Co.; F. L. Miller, Standard Oil Development Co.; E. C. Paige, Ethyl Corp.; J. H. Mack, Chrysler Corp.; and Lt.-Col. Allan C. Bigelow, Holabird Motor Base. Back row, left to right: J. C. Zimmer, Standard Oil Development Co., E. R. Barnard, Standard Oil Co. of Indiana, A. O. Willey, Lubri-Zol Corp.; A. R. Black, Office Chief of Ordnance, C. W. Georgi, Quaker State Oil Refining Corp.; E. P. Gohn, Atlantic Refining Co.; E. N. Hatch, American Brakeblok Division, American Brake Shoe & Foundry Co.; H. R. DeSilva, Automotive Division, WPB; C. D. Brown, Studebaker Corp.; K. D. Smith, B. F. Goodrich Co.; and John C. Estabrooke, Holabird Motor Base. After a general discussion of the subject, Chairman T. C. Smith divided the subcommittee into the following functional groups to study the various phases of the problem: Brakes and Shock Absorbers; Chassis Lubrication, Greases, Front Wheel Bearings, and so forth; Inspection and Exterior Equipment; Gasoline and Fuel System; Tires; Gear Oils; Electrical Equipment; General; Engines. The nine Army officers sitting with the subcommittee provided information on Army background, practice and limitations

1943 edition are the "Classifications and Test Requirements for Rubber Compounds," developed by Subcommittees IV and V on natural and synthetic rubbers, respectively, of SAE-ASTM Technical Committee A on Automotive Rubber. Establishing a milestone in the simplification of selection and use of rubber compounds, these classifications and test requirements set up standard grades suitable for automotive rubber requirements other than tires and tubes when flexibility, resilience, or the absorption of noise or vibration is desired.

Three additions have been made to the steel specifications. The NE steel compositions, the Army-Navy Hardness-Tensile Strength Table, and the ASTM arithmetical form for plotting hardenability curves have been added as convenient references. In addition, the definitions of heat-treating terms have been revised to conform to latest metallurgical practice.

Among other new specifications introduced in the 1943 Handbook are the SAE "Recommended Practices for Maintenance Instruction Cards for Motor Vehicles," published together with indexing and filing instructions, developed by SAE-ODT Committee No. 17; completely new specifications for spring lock washers formulated by Sectional Committee (B 27) operating under ASA procedure; specifications on lamps for military motor vehicles. In addition the SAE Gasoline Engine Test Code has been revised completely by the Gasoline Engine Division.

The extensive additions and revisions to SAE Aeronautical Material Specifications (AMS), Aeronautical Standards (AS), Aeronautical Recommended Practices (ARP), and Aeronautical Information Reports (AIR), that have been made during 1942 through intensive activity by the Aeronautics Division, are listed in the Aeronautical Section of the new Handbook.

To set up a procedure for fast action during the present emergency, a section on "War Emergency Recommended Practices" has been added to the Standards Committee Regulations in the introduction of the Handbook.

Sees Natural Rubber Regaining Supremacy

■ *St. Louis*

THE rubber and gasoline rationing program and its operation in this area was the subject discussed by William H. Bryan, state rationing officer, Office of Price Administration, when he spoke before the St. Louis Section on March 31. James Windram of the B. F. Goodrich Co., the second speaker of the evening, told of the rubber problem in the United States today.

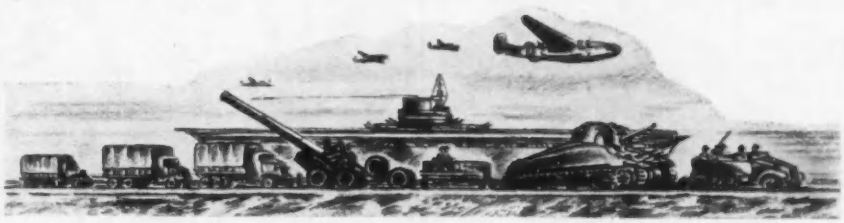
Many of the problems which confront the rationing board are due to misunderstandings, explained Mr. Bryan. He said that the people's response is good when they understand the reasons for rationing.

A moving picture, "Keep 'Em Rolling," was presented as part of Mr. Windram's talk on the synthetic rubber program and its present status. In Mr. Windram's opinion, natural rubber will again be supreme in many fields when supplies of the raw material are available. However, he said, many of the specialized synthetics will have a great many uses as they will be able to do things which cannot now be done with natural rubber.

SAE WAR MATERIEL MEETING

Book Cadillac Hotel — **Detroit**

June 9 and 10



WEDNESDAY, JUNE 9

Morning — Truck and Bus

Lessons Learned from World War II about Designing for Accessibility
– Col. E. S. Van Deusen, Tank-Automotive Center

Shot Blasting to Increase Fatigue Resistance
– J. O. Almen, General Motors Corp.

Afternoon — Passenger Car

Various Types of Tank Engines Compared
– Lt. Col. R. J. Icks, Tank-Automotive Center

Suspensions for Fast Track-Laying Military Vehicles
– Lt.-Col. Joseph M. Colby, Chief, Development Branch, Tank-Automotive Center

Evening — Production

Prevailing Inspection Methods
– O. J. Snyder, Cadillac Motor Car Division, General Motors Corp.

THURSDAY, JUNE 10

Morning — Passenger Car

Dust Problems in Military Vehicle Operation
– L. F. Overholt, International Harvester Co., Inc.

Substitution of Steel for Aluminum in Brake Cylinder Pistons
– J. F. Bachman, Chrysler Corp.

Afternoon — Truck and Bus

Looking at the Future through the Eyes of Research
– C. F. Kettering, General Motors Corp.

DINNER

(Sponsored by Detroit Section)

Welcomes SAE Members in London

The Institution of Automobile Engineers in London extends a cordial invitation to SAE members visiting England in connection with the war effort, either in military or civil capacity, to make use of the facilities of the Institution.

During the winter months General Meetings took place in Birmingham, Manchester and Luton, but they are expected to be resumed in London in the Spring.

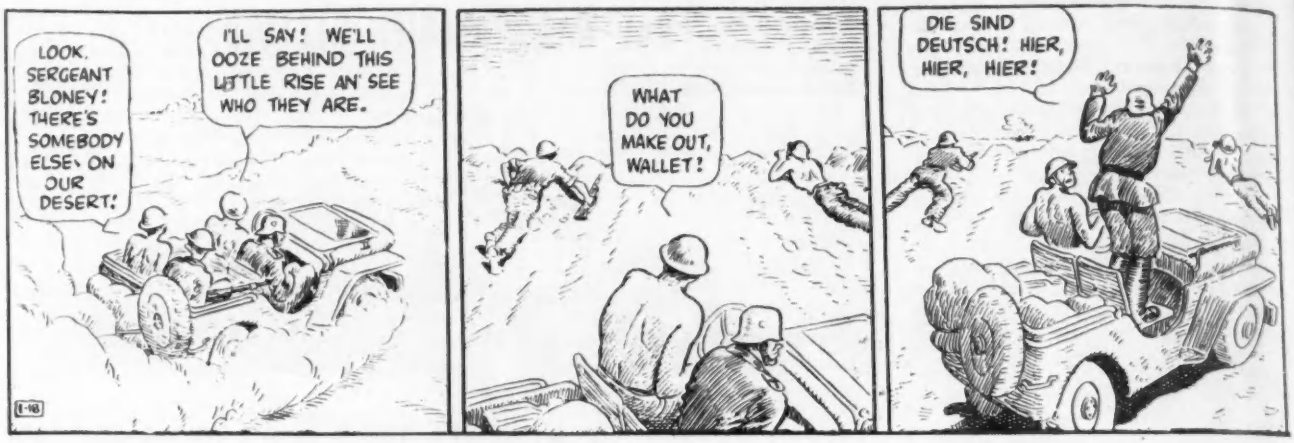
Mr. E. B. Haggerty, acting secretary, advises that the Institution can furnish members with letters of introduction to any automobile executives whom they wish to contact while in that country. There is also a library and reading room for their general use at 12 Hobart Place, London, S.W.I.

Exchange of Parts System Prevents Production Delay

■ *SAE Colorado Group*

A film showing the purposes of the tractor in farming was presented at the March 16 meeting of the SAE Colorado Group. The film, entitled "Let's Grow," which was shown by H. A. Hughes of the McCarty-Sherman Distributing Corp., had an introduction by Claude Wickard, secretary of agriculture and food administrator.

Henry Winters of the Winter-Weiss Co. gave a short talk on the cooperation of manufacturers in keeping plants going by the system of exchanging parts between these various plants, preventing delay in war production.


LOOK, SERGEANT BLONEY! THERE'S SOMEBODY ELSE ON OUR DESERT!
I'LL SAY! WE'LL OOZE BEHIND THIS LITTLE RISE AN' SEE WHO THEY ARE.
WHAT DO YOU MAKE OUT, WALLET!
DIE SIND DEUTSCH! HIER, HIER, HIER!

SAE Ordnance Committee B For Special Standard Projects

SAE Ordnance Committee B has been established to handle any special standardization projects which may be requested by the Armed Forces, particularly those involving primarily land equipment. Typical of the projects which, from now on, the SAE War Activity Council will refer to Ordnance Advisory Committee B are those which last year were completed by the SAE Quartermaster Corps Advisory Committee. (See *SAE Journal* May, 1942, p. 23.) This latter committee has been disbanded and its remaining work encompassed by the new Ordnance Committee B.

The 23-year old SAE Ordnance Advisory Committee, of which Col. H. W. Alden is chairman, continues its work under the designation of SAE Ordnance Advisory Committee A.

The end-product of any work done by Ordnance Advisory Committee B will be advice or recommendations to the Armed Forces as regards the feasibility of certain standardization. Any action or issuance of standards will emanate from the Armed Forces. Thus, it is clear, the procedures, as well as the objectives, of the new committee are distinct from those of regular SAE Standards Committee operations where the end-product is an SAE Standard or SAE Recommended Practice issued by the SAE itself.

The working standardization teams already existing as divisions of the regular SAE Standards Committee, however, will be utilized to speed results for Committee B – and J. H. Hunt, chairman of the SAE Standards Committee, has been named chairman of Ordnance Advisory Committee B. Here is how existing SAE standards personnel will function in assisting the new group:

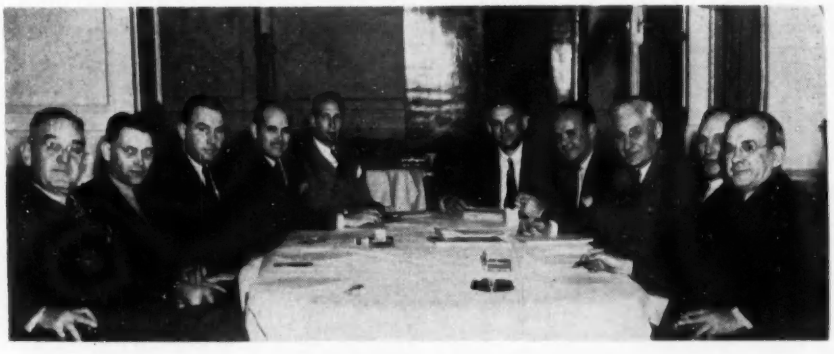
To Get Army Inquiries

Committee B will receive inquiries directly from the Army, assigning them to the appropriate division of the General Standards Committee, which in turn is authorized to organize subdivisions to handle the projects. After the subdivision has drawn up a report, which has been circularized for comment to both the division that organized it and a representative cross-section of the industry involved in the project, the subdivision is to report directly to Committee B. This latter committee will review the report and approve it for transmission to the Army as the recommendation of the committee.

Serving with Mr. Hunt on Ordnance Advisory Committee B are:

C. J. Bock, General Motors Truck and Coach Division, Yellow Truck and Coach Mfg. Co.; Adolf Gelpke, Autocar Co.; Ernest Lamb, Chrysler Corp.; and J. G. Wood, Chevrolet Motor Division, General Motors Corp.

SAE Hard Surfacing Group Meets



SAE-ODT Subcommittee 11 meets to discuss "Hard Surfacing – Applications and Technique." Left to right: Floyd Clothier, Bureau of Water Works & Supply, City of Los Angeles, L. E. McKibben, Lang Transportation Co., W. R. Smith, The Lincoln Electric Co., J. H. Barbour, Magnaflux Corp., Stanton F. Olson, Magnaflux Corp., A. (Gus) Martin, Pacific Freight Lines, George Griffin, Jr., The Stoody Co., Ellis W. Templin, Bureau of Power and Light, City of Los Angeles, W. Wesley Mills, W. W. Mills Laboratories, E. V. Thurston, Haynes-Stellite Co. Messrs. Clothier, McKibben, Smith, Barbour, Olson, and Mills were invited guests at this particular session. F. C. Emery, Air Reduction Sales Co., was absent

SAE Groups Receive Official Recognition

New impetus was given to the growth of SAE Groups and Clubs, when the SAE Council recently established official regulations by which these previously informal organizations are given a more formal status as part of the Society structure.

From now on "SAE Group" will be the standard designation for "organizations of members of the SAE located in centers outside of Section territory and formed to schedule technical meetings for members in the area and to extend Society activities in such ways as may be approved by the Council from time to time."

When, upon petition, such a Group is recognized by the Council, it will be with the understanding that the Group will petition for Section status at a time when its membership activities warrant such action. Territories of the Groups will be approved by the Council and recognition will be renewed annually.

To help defray expenses of the Groups

DESERT, AHOY!

SIT DOWN, YOU LUG, OR I'LL BASH THAT TIN CAN OF YOURS DOWN INTO YOUR I.Q., IF ANY.
Reg. U. S. Pat. Off.: Copyright, 1943, by The Chicago Tribune.

"The Gasoline Alley cartoons are the best portrayals of terrain conditions, natives, weather, and the feelings of the individual soldiers that I have yet seen anywhere."

– Lt.-Col. Joseph M. Colby, Ordnance Department
(At SAE War Engineering Production Meeting in Detroit, January, 1943)

American Tanks — Design Features and Performance

▪ *Metropolitan*

"Our tanks are second to none, and our tanks have more firepower, mobility, and armor than any others of comparable weight," Lt.-Col. Joseph M. Colby, chief, Development Branch, Tank-Automotive Center, assured members and guests at the Metropolitan Section meeting on March 18.

Over 300 heard Lt.-Col. Carl E. Cummings of the Army Ordnance Department, and Col. Colby, discuss "Power and Its Transmission in Modern Tanks."

Col. Cummings, who spoke first, covered the general design features and practices of American tanks. He named the military requirements of tank design as firepower, mobility, and protection.

Features of aircooled and liquid-cooled engines – both Otto cycle and diesel – were discussed, and the effects of cooling systems, fuel economy, fuel systems, engine shape, clutch designs and drive systems upon tank design characteristics also were noted.

Slides showing various types of tanks, engine installations and cross-sections of components of the tanks, and slides showing foreign designs illustrated Col. Cummings' talk.

Col. Colby followed Col. Cummings' design discussion with an account of his experiences on the African battlefields and commented on the performance of our tanks and foreign tanks in actual service.

during their period of organization and growth, the Society hereafter will rebate to each group an amount equivalent to three-fifths of the amount of dues per member received in the case of Sections.

Four Groups were already functioning actively at the time this Council action was taken to encourage further growth of the same kind. With SAE membership growing rapidly outside existing Section territories – and with increasing restrictions on transportation – the part which these Groups play in the structure of the Society is becoming more and more important.

Already existing Groups are: Colorado Group, Mohawk-Hudson Group, Muskegon Club, and Peoria Group.

Maintenance and Air Travel Go on In Spite of Handicaps

▪ *Indiana*

The unique and extraordinarily difficult conditions under which all air travel and activity in the Middle East are conducted were vividly brought out at the March 30 meeting of the Indiana Section, at which Clyde R. Paton, executive engineer of General Motors' Allison Division, spoke.

Mr. Paton showed approximately 200 slides at this off-the-record meeting – many of them in color – dealing with general conditions in that area last December and January when he was there on special assignment. Part of the presentation dealt with technical details of maintenance, a stupendous task that was successfully carried out, as later events proved.

An RAF sound film was also shown with action views of various elements operating their own and U.S.-made aircraft.

Eliminations in Flier Training Course Occur Mostly in First 20 Hr of Flying

▪ *Detroit*

The latest improved training technique for Army combat fliers was described by Col. Thomas J. DuBose, chief of the Air Crew Training Division, Army Air Forces, before the Detroit Section on April 12. Col. DuBose replaced as speaker Brig.-Gen. Luther W. Smith who was unexpectedly called out of the country.

In addition to Col. DuBose's address there was a motion picture, "How to Fly a B-26 Airplane."

Col. DuBose compared the training schedule for cadets to the assembly line methods of the automobile industry. Roughly speaking there are seven phases to this process between the time the raw recruit becomes an aviation cadet and the time he leaves as a finished flier for one of the theaters of war, master of every trick which the Jap and Nazi Fliers have employed against us; perfect in his gunnery to the point where it is *his* shots which send the Focke-Wulf or the Zero hurtling earthward, a mass of flame and black smoke.

In the first phase, the cadet is sent to a basic training center for four weeks. He is given a physical examination, receives his innoculations and his uniform.

The second phase of his training, Col. DuBose said, is a five-month college course in one of the schools under contract to the Air Forces. Instruction in physics, history, English, geography and mathematics is given. During the fifth month of this training the cadet is given 10 hours dual-control flying time in a "puddle-jumper" type of plane. This serves as a screen to eliminate those cadets who have an innate fear of flying or who cannot qualify as pilots through no fault of their own, Col. DuBose stated.

Upon completion of the college training work, the cadet is sent to one of the three Air Forces Classification Centers where, after intensive psychological tests, it is determined whether he has the aptitude required for further pilot training. Col. DuBose explained that the traits which have been found most desirable in pilots are good judgment; mechanical comprehension; foresight; quick and accurate observation; ability to visualize; flexibility of attention; visual-motor coordination, and aviation interest. Lack of some of these traits, however, does not hinder training as a bombardier, navigator, or aerial gunner, and experience at reception centers has demonstrated that from 8 to 10 per cent of the trainees will be eliminated as prospective flying personnel. These groups are sent to other technical schools of the Air Forces for specialized training.

The fourth phase of training is the preflight school. For nine weeks the cadet studies meteorology, radio code, map and chart reading.

During the fifth stage of his training the cadet meets the military plane. This is a nine-week course with 60 hours flying time. His instructors are civilian pilots under the supervision of the Air Forces officers. It is during this part of training that the greatest number of eliminations generally occurs – usually during the first 20 hours of flying. Toward the end of the course the cadet is given acrobatic flying instruction and these maneuvers are repeated, using heavier and faster types of aircraft. The cadet's ground school and military training are continued and such studies as navigation, aircraft recognition

and radio code are stressed, Col. DuBose said.

During the basic training school period of nine weeks the cadet studies under military instructors for the first time. He gets 70 hours flying time in the Vultee BT-13, a 450 hp plane. He repeats maneuvers taught in primary training but more accuracy and greater exercise of judgment are demanded. He receives his first instrument flying training, is introduced to night flying and is soloed at night. He is also sent on navigation flights by himself and is required to land at a strange airdrome. During this phase of the training failure to exercise judgment is the paramount cause of elimination, Col. DuBose said.

Up to now the instruction program has been identical for all pilots irrespective of physical stature. Col. DuBose pointed out that every effort is being made to cut down the weight of aircraft in order to provide greater maneuverability and better performance. Hence, physical stature determines whether an individual becomes a fighter pilot or a bomber pilot. Consistent with physical requirements, cadets are given the choice of service.

The cadet fighter is sent to one of the advanced single-engine schools where he receives 80 hours of further instruction. The cadet bomber pilot is sent to one of the twin-engine schools where he receives 70 hours instruction. Both are nine-week courses.

At the single-engine school the cadet must become proficient in the handling of the AT-6, or North American plane, powered with a 650 hp engine. He continues to improve his efficiency in execution of maneuvers learned earlier, Col. DuBose said. Additional instrument flying is given, namely radio beam flying; longer navigation flights, and for the first time he uses oxygen for high-altitude flying. He fires a fixed gun for the first time at both ground and air targets. He takes off for the first time in a single-seater tactical type plane, the P-40, which has proved to be an excellent trainer. Once the cadet masters the P-40 he is ready to begin operational training. In this, his last and final phase of training, he is taught the tactics and maneuvers which "may spell the difference between *his* life and death, *our* victory or defeat," Col. DuBose said.

During his nine-week training period the bomber cadet is introduced to a light twin-engine airplane ranging from 600 to 900 hp. He is taught to fly the aircraft on one engine, how to land with a dead engine, and he is given additional navigation training, intensive instrument flying training, mainly radio beam flying; low- and high-altitude missions, additional formation flying and, in some schools, forward firing of fixed guns to simulate ground strafing.

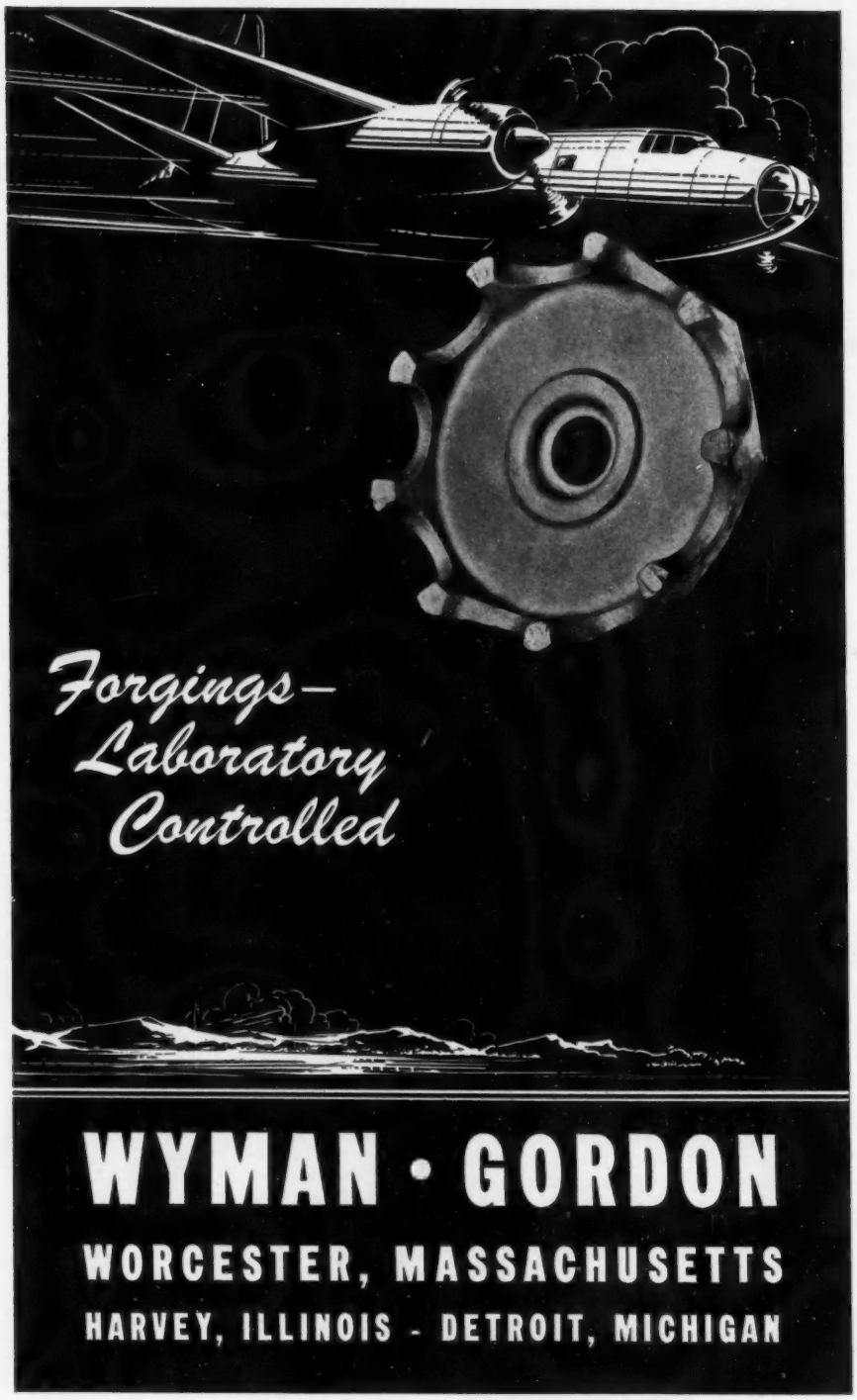
Four-Engine Training

Even though graduated from advanced training, the twin-engine student is not through. At this point he may ask for either medium bombardment, light or dive bombardment, or four-engine training. Those selected for four-engine training are sent to one of the several B-17 or B-24 schools and are given an additional nine weeks' intensive training comprising 105 hours of flying time. The ground school course is devoted to an intensive study of all operations of a four-engine plane. He does additional instrument flying, landings and take-offs with a full load, half load, and full military load, and long cross-country navigation flights, both day and night. Col. DuBose said that to simulate conditions in the war zones the cadet is taught to fly through bad weather of every kind.

In the final phase of the cadet's training – the operational training stage – the bomber pilot must learn teamwork.

"He is the leader of a crew whose every movement is integrated, whose every operation must be synchronized with each crew member, with other ships of the squadron, with the flights composing the group," Col. DuBose said.

During the question and answer period at the conclusion of the meeting, Col. DuBose explained that under a new program which has worked very well for the British, American pilots are being brought back to the United States after 30 combat missions to rest from the shock and severe physical strain under which they have worked while on these missions. After a rest period of from 90 to 120 days, some are returned to the war zones; about 5 to 10 per cent become instructors, and others act in an advisory capacity.



NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between March 10, 1943, and April 10, 1943. The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section

Bowman, W. S. (J) junior engineer, Automotive Branch, Proof Division, Aberdeen Proving Ground, Md. (mail) R. F. D. 2, Havre de Grace, Md.

Chicago Section

Anderson, E. B. (M) chief engineer, Mechanics Universal Joint Division, Borg-Warner Corp., Rockford, Ill. (mail) 2135 10th St.

Breer, Carl Frederick (J) production test engineer, Dodge Chicago Plant, Division, Chrysler Corp., P. O. Box 5670A, Chicago (mail) 6930 S. Shore Dr.

Groenier, John (A) partner, Axle & Equipment Sales Co., 211 E. 23rd St., Chicago (mail) 1650 W. 104th St.

Hay, H. Kenneth (J) layout draftsman, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind. (mail) 918 Elmer St.

Jacobson, Walter E. (M) chief checker, Buda Co., 154th & Commercial Ave., Harvey, Ill. (mail) 14209 Michigan Ave., Riverdale, Ill.

Pope, Hugh (A) assistant sales manager, National Malleable & Steel Castings Co., 1400 S. 52nd Ave., Cicero, Ill.

Ruge, Irwin W., 2nd Lt. (J) assistant engineering officer, U. S. Army Air Forces, 97th Sub-Depot Engrg., Craig Army Air Field, Selma, Ala. (mail) 139 Country Club Road, Chicago Heights, Ill.

Thrush, Jesse J. (SM) chief inspector, U. S. Army, Ordnance Department, 38 S. Dearborn St., Chicago (mail) 15311 Myrtle, Harvey, Ill.

Townsend, F. Lee (A) sales engineer, Wm. W. Nugent & Co., Inc., 410-412 N. Hermitage Ave., Wicker Park St., Chicago.

Cleveland Section

Allen, Raymond W. (M) engineer, Firestone Tire & Rubber Co., Akron, Ohio.

Balogh, Roy O. (J) mechanical engineer, Weatherhead Co., 300 E. 131st St., Cleveland.

Beckwith, Rexford P. (A) representative, Cleveland Ordnance District, 1006 Terminal Tower, Cleveland (mail) 19534 Center Ridge Rd., Rocky River.

Bell, Arthur H. (J) National Advisory Committee for Aeronautics, Cleveland (mail) 3904 Riveredge Rd.

Berg, Herbert H. (J) tool engineer, Weatherhead Co., 300 E. 131st St., Cleveland.

Caster, John E. (M) district manager, Cincinnati Milling Machine Co., Cincinnati (mail) 94 Euclid Ave., Willoughby, Ohio.

DeGraff, Wilbur C. (M) manager, sales engineering, Warner & Swasey Co., 5701 Carnegie Ave., Cleveland.

Fenker, Grafton F. J. (J) lubrication technician, Pennsylvania Refining Co., 2686 Lisbon Rd., Cleveland.

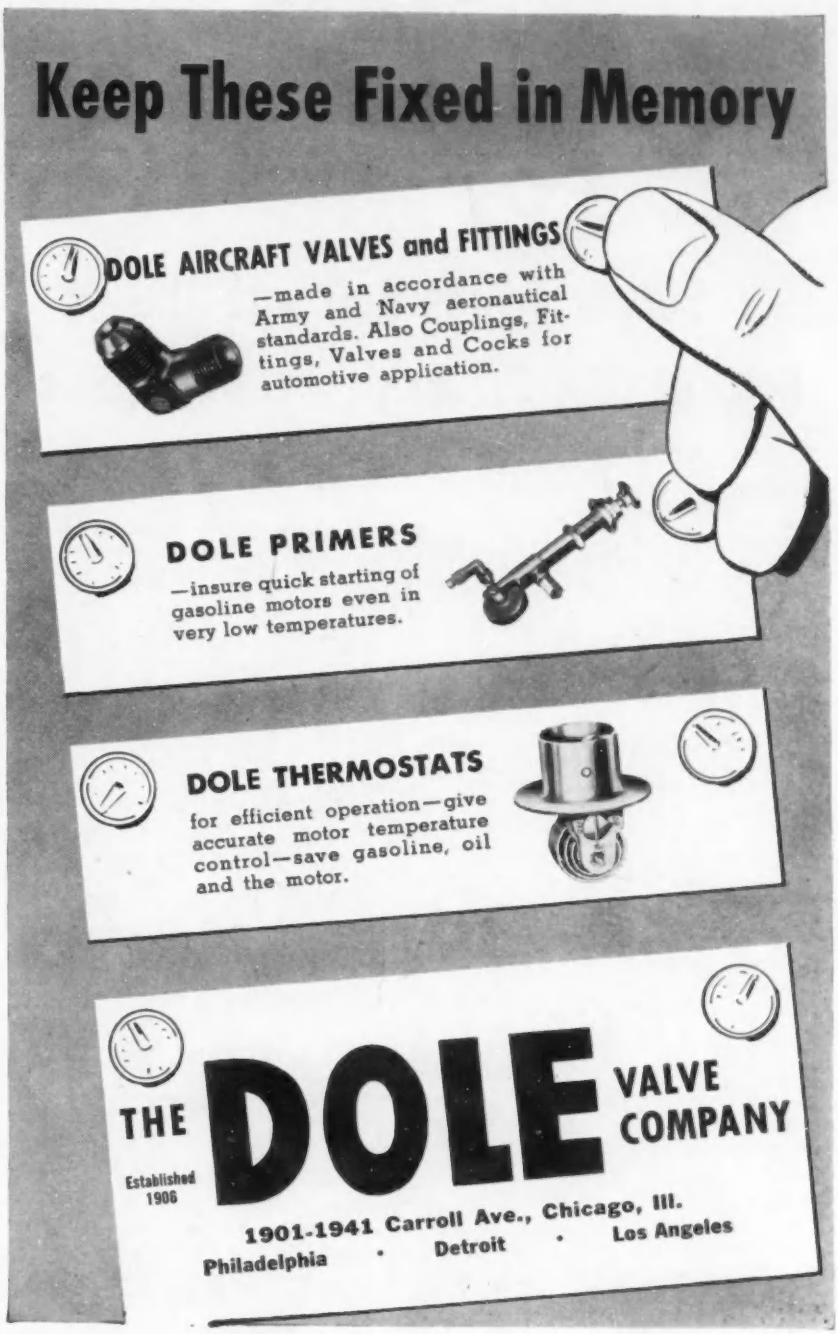
General Tire & Rubber Co. (Aff.) Englewood Ave., Akron, Ohio. Reps: Dodge, Howard M., general manager, mechanical goods division, Wabash, Ind.; Kraft, Herman T., chief experimental engineer; Orr, Vance Hall, engineer, interplant department; Pushee, H. B., manager, development department.

Gilchrist, David, Jr. (A) personnel director, Weatherhead Co., 300 E. 131st St., Cleveland.

Hackett, Glenn N. (A) purchasing agent, Thompson Aircraft Products Co., 23555 Euclid Ave., Cleveland.

Judd, Charles Henry (A) chief engineer, Tinnerman Products, Inc., 2038 Fulton Rd., Cleveland.

Karabinus, Andrew (A) general (plant) superintendent, Thompson Products, Inc., 2196 Clarkwood Ave., Cleveland (mail) 18493 High Parkway, Rocky River, Ohio.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Keel, Knut O. (M) chief engineer, Cleveland Diesel Engine Division, General Motors Corp., 2160 W. 106th St., Cleveland.

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Morse, C. R. (J) associate mechanical engineer, National Advisory Committee for Aeronautics, Cleveland Airport, Cleveland (mail) 399 Oak Cliff Dr., Bay Village, Ohio.

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Wurzburger, Paul D. (M) engineer (advising), Weatherhead Co., 300 E. 131st St., Cleveland (mail) 2527 Derbyshire Rd., Cleveland Heights, Ohio.

Detroit Section

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Johnson, Ralph S. (J) gear calculator, Chevrolet Gear & Axle Division, General Motors Corp., 1840 Holbrook, Detroit (mail) 9924 Whitcomb.

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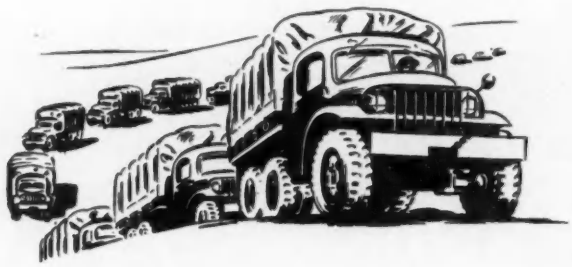

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Peoria Group

Comer, William Harold (J) engineering checker, Caterpillar Tractor Co., Peoria, Ill.

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Southern California Section

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Davis, Harold McDonald (A) vice-president, general manager, Aero-Coupling Corp., 1051 N. Hollywood Way, Burbank, Calif.

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LaFrentz, Fred H. (A) district manager, American Liquid Gas Corp., 1109 Santa Fe Ave., Los Angeles.

Moore, W. D. (J) hydraulic engineer, Douglas Aircraft Co., Inc., El Segundo, Calif. (mail) 5049 W. 118th St., Hawthorne, Calif.

Nordlinger, Louis S., Jr. (J) junior weight engineer, Lockheed Aircraft Corp., 1705 Victory Pl., Burbank, Calif. (mail) 5444 Simpson Ave., North Hollywood, Calif.

Reeves, Leland S., Major (SM) automotive officer, U. S. Army, Quartermaster Corps, Camp Callan, San Diego, Calif.

Scott, Hugh F. (M) superintendent, Frazier Wright Co., 2315 S. Hill St., Los Angeles (mail) 2774 Glenn Ave.

Wilkes, Thomas Marion, Major (SM) U. S. Army, Ordnance Department, 3rd Battalion, 126th Ordnance Motor Base Shop Regiment, Pomona Ordnance Base, Pomona, Calif.

Southern New England Section

King, Lyman H. (A) master mechanic, Roger Sherman Transfer Co., Hartford, Conn. (mail) 22 Denison St.

Lamphere, Richard W. (M) development engineer, American Bosch Corp., 3664 Main St., Springfield, Mass.

Litchfield, Arthur K. (M) sales engineer, Raybestos Division, Raybestos-Manhattan, Inc., P. O. Box 1021, Bridgeport, Conn.

Southern Ohio Section

Camping, Robert Lewis (M) project engineer, Aeroproducts Division, General Motors Corp., Vandalia, Ohio (mail) 117 W. Monument Ave., Dayton, Ohio.

Hamilton, Robert C. (J) test engineer, Wright engine project office, power plant laboratory, U. S. Army Air Corps, Headquarters Squadron, Materiel Command, Wright Field, Dayton, Ohio.

Small, George E. (J) mechanical engineer, Universal Cooler Corp., Marion, Ohio (mail) 1188 Indiana Ave.

Wood, Walter A., Jr. (J) junior test engineer, Wright Aeronautical Corp., Division, Curtiss-Wright Corp., Lockland, Ohio (mail) 2315 Adams Ave., Norwood, Ohio.

Syracuse Section

Spase, Charles B. (M) chief engineer, clutch division, Lipe-Rollway Corp., 208 S. Geddes St., Syracuse, N. Y.

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Johnsen, **W. H.** (A) owner, Technical Chemical Co., Dallas, Tex. (mail) P. O. Box 4125.

Kent, **Frank D.** (A) president, Frank Kent Motor Co.; Frank Kent Mfg. Co., Main at Lancaster, Fort Worth, Tex.

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Thaheld, **Fred A.** (M) research engineer, Guiberson Diesel Engine Co., Dallas, Tex. (mail) P. O. Box 1106.

Washington Section

Wismeyer, **Carl F.** (A) chairman of board, managing director, C. F. Wismeyer & Co., Inc., Brussels, Belgium (mail) Hotel Clarridge, 820 Conn. Ave., Washington.

Wichita Section

Crawford, **Farold R.** (A) tool and die department, Boeing Airplane Co., Wichita, Kan. (mail) 240 S. Volutsia Ave.

Outside of Section Territory

Donaldson, Frank Arthur, Jr. (J) project engineer, Donaldson Co., Inc., 666 Pelham Blvd., St. Paul, Minn.

Huff, Lee, Jr., Capt. (A) director, Officers' courses, U. S. Army, Ordnance Department, Fort Crook, Nebr. (mail) 4914 Dodge St., Omaha, Nebr.

Krueger, George Arthur (J) engineer, Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N. Y. (mail) 8603 Lindbergh Ave., Niagara Falls, N. Y.

McDaniel, Lee L. (A) owner, Lee L. McDaniel Automotive Maintenance & Repairs, Box 1972, 204 W. Oak St., Globe, Ariz.

Neyhart, Amos Earl (M) road training consultant, American Automobile Association Administrative Head, Institute of Public Safety, Pennsylvania State College, State College, Pa.

Niness, William E. (M) sales manager, Fuller Mfg. Co., Kalamazoo, Mich.

Risk, Norman E. (M) assistant chief engineer, Caterpillar Military Engine Co., Decatur, Ill. (mail) 616 E. Adams St., Morton, Ill.

Roig, Lester C., Lt. (SM) post motor maintenance officer, U. S. Army, Ordnance Department, Automotive Branch, Fort Bragg, N. C.

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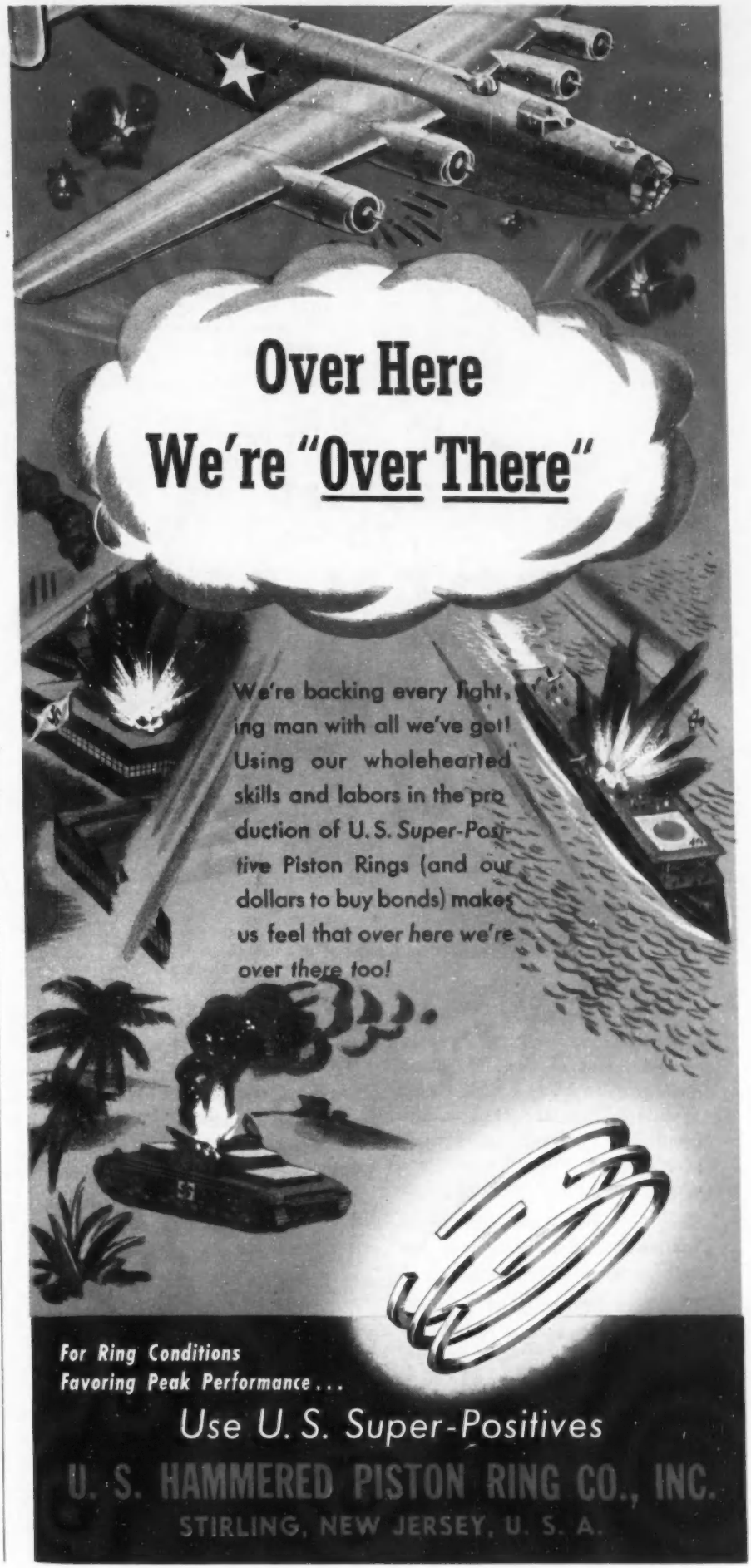
Robson, John Henry (FM) service engineering director, British Overseas Airways Corp., Clifton, Bristol, England.

Twelvetrees, Walter Noble (FM) inspector in charge, Ministry of Aircraft Production, London, S. W., England (mail) c/o Burtonwood Repair Depot, Warrington, England.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APPLICATIONS Received

The applications for membership received between March 10, 1943, and April 10, 1943, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section

Bartholomee, Eugene T., working supervisor, Glenn L. Martin Co., Middle River, Md.

Henderson, John M., Jr., Lt.-Col., U. S. Army, Preventive Maintenance Unit, Holabird Ordnance Depot, Baltimore.

Middleton, T. Blair, secretary and treasurer, The Middleton & Meads Co., Inc., Baltimore.

White, Gene H., aircraft hydraulic engineer, Adel Precision Products Corp., Burbank, Calif. Mail: 303 Wareham Bldg., Hagerstown, Md.

Buffalo Section

Badgley, Donald Norman, field engineer, Bendix Aviation Corp., South Bend, Ind. Mail: 2249 Delaware Ave., Buffalo.

Baitz, Arthur, test engineer, Sterling Engine Co., Buffalo.

Tirone, Stephen Anthony, research engineer, Curtiss-Wright Corp., Buffalo.

Canadian Section

Beckett, Ronald C., power plant engineer, Chrysler Corp. of Canada, Ltd., Windsor, Ont.

Forsyth, William, Capt., superintendent of automotive equipment, Toronto Transportation Commission, Toronto, Ont.

Coleman, Stanley L., sales engineer, Canada Wire & Cable Co., Ltd., Toronto, Ont.

Griffin, Vincent O., junior layout man, General Motors of Canada, Ltd., Oshawa, Ont.

Sadowski, Ben, president, National Motors Limited, Toronto, Ont.

Simmons, Cecil E., junior layout draftsman, General Motors of Canada, Ltd., Oshawa, Ont.

Wanko, J. P., methods engineer, Sealed Power Corp. of Canada, Ltd., Windsor, Ont.

Chicago Section

Adams, Charles L., engineer, Bendix Aviation Corp., South Bend, Ind.

Bonham, Ralph Fletcher, development engineer, Bendix Aviation Corp., South Bend, Ind.

Brown, Daniel, laboratory engineer, Armour Research Foundation, Chicago.

Chase, J. R., liaison engineer, Illinois Division, Bendix Aviation Corp., Chicago.

Coghlan, Frank X., factory service representative, Studebaker Sales Corp. of America, New York City. Mail: General Service Department, Studebaker Corp., South Bend, Ind.

Copeland, Alvin Beecher, customer engineer, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

Cross, Francis R., engineer, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

Faller, August, Jr., production airbox engineer, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

Fetters, Jack C., executive engineer, Electro-Motive Division, General Motors Corp., LaGrange, Ill.

Holloway, Don D., customer engineer, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

Layner, George A., engineer, Electro-Motive Division, General Motors Corp., LaGrange, Ill.

Letts, John, customer engineer, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

Slindee, Edward A., engineer, Bendix Aviation Corp., South Bend, Ind.

Spurgin, Wendell P., junior engineer, Bendix Aviation Corp., South Bend, Ind.

Sutley, Laurence P., assistant master mechanic, Dodge-Chicago Corp., Chicago.

Tichy, Woodrow, tool engineer, Dodge-Chicago Corp., Chicago.

Worley, William Edward, engineer, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

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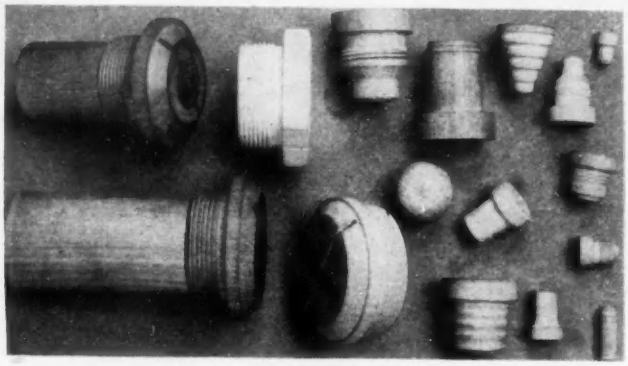

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Bollenbacher, Earle P., industrial engineer, Thompson Products, Inc., Cleveland.

Briggs, John H., president, The Gabriel Co., Cleveland.

Emery, E. Gifford, Jr., field representative, Pump Engineering Service Corp., division of Borg-Warner Corp., Cleveland.

Federkiel, Arthur J., vice-president and general manager, The J. C. Ulmer Co., Cleveland.

Federkiel, Joseph J., president, The J. C. Ulmer Co., Cleveland.

Fike, Russell R., development engineer, Thompson Products, Inc., Cleveland.

Friedl, Otto G., chief engineer, The J. C. Ulmer Co., Cleveland.

Graham, Glenn Robert, field engineer, Cleveland Graphite Bronze Co., Cleveland.

Grosser, Walter C., sales manager, production engineer, The J. C. Ulmer Co., Cleveland.

Groth, Quentin N., industrial engineer, Thompson Aircraft Accessories Division, Thompson Products, Inc., Cleveland.

Hoagland, Richard Havis, metallurgist, Canton Naval Ordnance Division, Westinghouse Electric & Mfg. Co., Canton, Ohio.

Martin, Paul E., Major, U. S. Army, Ordnance Department, Staten Island Terminal, Stapleton, S. I., N. Y. Mail: 131 Melbourne Ave., Akron, Ohio.

Pain, Edwin F., engineer, Aero Supply Co., Inc., Corry, Pa.

Pawek, Emil, assistant manager, The J. C. Ulmer Co., Cleveland.

Suki, George, industrial engineer, Thompson Products, Inc., Cleveland.

Sutter, C. Earl, development engineer, Goodyear Tire & Rubber Co., Akron, Ohio.

Szabo, Emery J., Jr., electrical engineer, Leece-Neville Co., Cleveland.

Detroit Section

Barclay, John A., Lt.-Col., U. S. Army, Ordnance Department, Tank-Automotive Center, Detroit.

Bertsche, Ralph, Jr., assistant electrical engineer, General Motors Truck & Coach, division of Yellow Truck & Coach Mfg. Co., Pontiac, Mich.

Binkelman, George Edward, manager, Detroit Ball Bearing Co., Toledo, Ohio.

Chance, Peter E., Capt., U. S. Army, Ordnance Department, Tank-Automotive Center, Detroit.

Farley, Nelson E., Jr., assistant research engineer, Willys-Overland Motors, Inc., Toledo, Ohio.

Goehmann, Wilbur L., chief tool engineer, Arrowsmith Tool & Die, Inc., Royal Oak, Mich.

Hildt, John McLean, Jr., supervisor, Ternstedt Mfg. Division, General Motors Corp., Detroit.

Huber, Robert A., tool inspector, Graham-Paige Corp., Detroit.

Kelly, Bernard J., industrial engineer, Liquid Cooled Engine Division, The Aviation Corp., Toledo, Ohio.

Malling, Frederick B., test engineer, Bendix Aviation Corp., South Bend, Ind. Mail: 1307 Eagle St., Niles, Mich.

Mills, Charlton F., research engineer, Ex-Cell-O Corp., Detroit.

Moore, T. P., treasurer, Detroit Ball Bearing Co., Detroit.

Peterson, Robert R., structures engineer, Dodge Division, Chrysler Corp., Detroit.

Rakas, Nicholas J., plastics engineer, Chrysler Corp., Detroit.

Riley, Sidney L., engineer, Wilcox-Rich Division, Eaton Mfg. Co., Detroit.

Scales, Richard K., assistant director, technical service department, Ethyl Corp., Detroit.

Simmons, R. S., time study assistant, Ford Motor Co., Dearborn, Mich.

Skinner, Robert T., assistant to president, Skinner Purifiers, Inc., Detroit.

Spring, Elmer H., engineer, Ford Motor Co., Dearborn, Mich.

Stadt, Harry L., manager, Detroit office, The Bossert Co., Inc., Detroit.

Stone, John McClure, junior engineer, Research Laboratories Division, General Motors Corp., Detroit.

Van Dell, Clarence A., test and quality engineer, Chevrolet Gear & Axle Division, General Motors Corp., Detroit.

Wait, Edgar Frederick, general superintendent, Ford Motor Co., Dearborn, Mich.

Ward, Charles S., sales manager, Detroit Ball Bearing Co., Detroit.

Warner, Clifton Adelbert, purchasing agent, Continental Aviation & Engineering Corp., Detroit.

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Kelly, Vincent Robert, foreman, heat treating, Propeller Division, Curtiss-Wright Corp., Indianapolis.

Myers, Robert C., process engineer, Perfect Circle Co., Richmond, Ind.

Putnam, Adelbert M., tool engineer, Propeller Division, Curtiss-Wright Corp., Indianapolis.

Wall, Alexander C., engineer, P. R. Mallory & Co., Inc., Indianapolis.

Yonash, Robert Frank, chief tool engineer, American Central Mfg. Corp., Connersville, Ind.

Metropolitan Section

Babey, John, toolmaker, Breeze Corporations, Inc., Newark, N. J.

Bartlett, Anderson Gordon, 1st Lt., U. S. Army, Quartermaster Corps, Petroleum Branch, New York City.

Bauer, Edward Christian, chief draftsman, Titeflex Metal Hose Co., Newark, N. J.

Brooks, Basil W., leadman, assembly inspection, Ranger Aircraft Engines, division of Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y.

Brooks, Frederick T., senior production engineer, Lockheed Aircraft Corp., Burbank, Calif. Mail: A.A.F. Station S-597, APO 636, New York City.

Cleaver, H. P., works manager, Greenport Basin & Construction Co., Greenport, L. I., N. Y.

Colieran, Thomas J., chief engineer, Hunter Sash Co., Inc., Flushing, N. Y.

Colson, William J., flight engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Paterson, N. J.

Dorman, Forrest L., engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Edwards, Milton Frank, aeronautical engineer, Academy of Aeronautics, Inc., Municipal Airport, Jackson Heights, N. Y.

Federico, Salvatore Theodore, supervisor, production test department, Ranger Aircraft Engines, division of Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y.

Katcher, Morris, consulting engineer, Modern Engineering Co., New York City.

Kopple, Robert, vice-president and general manager, Columbia Aircraft Products, Inc., New York City.

Kuhn, Russell C., toolmaker, Breeze Corporations, Inc., Newark, N. J.

Lary, Frank Byrd, field engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Paterson, N. J.

Maitland, Leonard Laurence, engineer, Greer Hydraulics, Inc., New York City.

Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc., Passaic, N. J.

Marvin, Philip R., chief metallurgical engineer, Marine Division, Bendix Aviation Corp., Brooklyn, N. Y.

McConnell, Edmond, production manager, aeronautical wires and cables, United States Rubber Co., New York City.

McElhone, J. Bruce, shop foreman, A & T Parts, Long Island City, N. Y.

Molloy, Robert E., Lt., assistant production officer, U. S. Army, 2nd Bn., 126 Ordnance Motor Base Shop Regt., Staten Island, N. Y.

Rocky, Joseph E., engineer, Breeze Corporations, Inc., Newark, N. J.

Schnell, Emil, machine tool department foreman, Hygrade Products Co., Inc., Long Island City, N. Y.

Shefrin, S. Joseph, propeller test engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Sherwin, John P., vibration engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Shorey, Harry S., Jr., engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Stehman, Frederick Godfrey, methods engineer, Eastern Aircraft Division, General Motors Corp., Linden, N. J.

Thomson, Faulkner Crain, engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Voorhies, Donald A., head, tool department, Anchor Optical Corp., New York City.

Webber, William, diesel engineer, General Motors Overseas Operations, New York City.

Mid-Continent Section

Church, Orville Joseph, tire inspector and sales manager, Salty & Lucky Fullerton Tire Co., Oklahoma City, Okla.

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Kleist, Lester E., draftsman, Allis-Chalmers Mfg. Co., Milwaukee.

Knoll, Jesse C., drafting, design, Allis-Chalmers Mfg. Co., Milwaukee.

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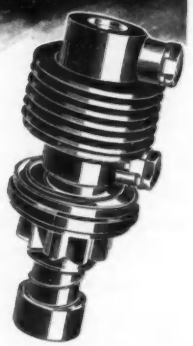

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Pleyte, Thomas William, experimental engineer, LeRoi Co., Milwaukee.

Stuth, Robert F., general superintendent, Kiekhaefer Corp., Cedarburg, Wis.

Mohawk-Hudson Group

Mires, Raymond D., engineer, General Electric Co., Schenectady, N. Y.

New England Section

O'Neil, James D., dynamometer operator, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn. Mail: 77 Delcar St., Fall River, Mass.

Scott, George C., Jr., Lt., (j.g.) USN, 767 Central St., Framingham, Mass.

Sherman, Windsor Lewis, Ensign, USNR, 60 Pitman St., Providence, R. I.

Soderberg, C. Richard, Prof., Massachusetts Institute of Technology, Cambridge, Mass.

Northern California Section

Bradley, Richard Frank, manager, aviation sales, Standard Oil Co. of Calif., San Francisco.

Dale, Clifford, supervising instructor, U. S. Army, Fort Ord Motor School, Fort Ord, Calif.

Gatter, Mountford Val, automotive instructor, California State Board of Education, Fort Ord, Calif.

Klingbeil, Lawrence G., transportation superintendent, Kraft Cheese Co., San Francisco.

Scholer, Gunner Laurits, research engineer, Standard Oil Co. of Calif., San Francisco.

Thompson, Edwin D., Lt., final inspection foreman, U. S. Army, 2nd Bn., 126 Ord. M.B.S. Regt., Staten Island, N. Y. Mail: 2591 Harkness Ave., Sacramento, Calif.

Northwest Section

Abbott, Albert E., proprietor, Power City Machine Shop, Spokane, Wash.

Baump, Armond M., automotive electrician, Gill Automotive, Spokane, Wash.

Brewitt, Edward H., salesman, Washington Machine & Supply Co., Spokane, Wash.

Gladwin, Harold Sterling, Jr., engineering, Boeing Aircraft Co., Seattle, Wash.

McCormick, Loren W., field service specialist, Colyear Motor Sales Co., Spokane, Wash.

Naylor, C. Fred, assistant division manager, Ethyl Corp., Seattle, Wash.

Oregon Section

Hartman, Carl F., district manager, Perfect Circle Co., Portland.

Stover, William M., field service and sales, Sealed Power Corp., Muskegon, Mich. Mail: 3866 S. E. Madison, Portland.

Peoria Group

Fenn, George P., assistant manager, engine department, Caterpillar Tractor Co., Peoria.

Kent, Nicholas, engineering student, Bradley Polytechnic Institute, Peoria.

Philadelphia Section

Essl, Max, consulting engineer, The Baldwin Locomotive Works, Philadelphia.

Ferris, Edward N., automotive supervisor, Diamond Ice & Coal Co., Wilmington, Del.

Giampapa, Cirino, project engineer, Eastern Aircraft Division, General Motors Corp., Trenton, N. J.

Pittsburgh Section

Ballinger, Clay, assistant factory manager, American Bantam Car Co., Butler, Pa.

Smith, Ronald B., manager, development engineering, Elliott Co., Jeannette, Pa.

St. Louis Section

Bouton, Innes, chief of structures, Laister-Kauffmann Aircraft Corp., St. Louis.

Knoebel, Walter C., experimental engineer, McQuay-Norris Mfg. Co., St. Louis.

Reading, Hugh D., project engineer, McQuay-Norris Mfg. Co., St. Louis.

Southern California Section

Beardsley, Jerome F., lecturer, diesel theory, Hemphill Institute of Technology, Los Angeles.

Brown, Harry, automotive adviser, U. S. Army Air Forces, Long Beach Army Air Field, Long Beach, Calif.

Cuthbert, Gertrude A. (Miss), staff assistant to tooling superintendent, Timm Aircraft Corp., Van Nuys, Calif.

Findeisen, John O., Jr., aircraft accessories engineer, Thompson Products Inc., Hollywood, Calif.

Finlay, Keith F., metallurgist, AiResearch Mfg. Co., Los Angeles.

Fowble, Robert Henry, mechanical draftsman, Consolidated Vultee Aircraft Corp., San Diego, Calif.

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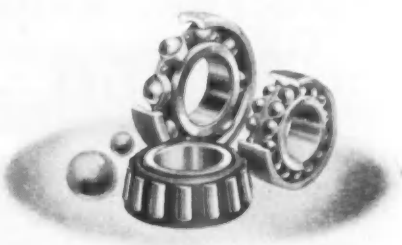

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Gabbert, Andy R., tool designer, Howard Hughes Aircraft Co., Venice, Calif.

Jones, Norman M., lubrication engineer, Macmillan Petroleum Corp., Los Angeles.

Kay, Morris A., principal automotive instructor, U. S. Army, Pomona Ordnance Motor Base, Pomona, Calif.

Mangan, Robert T., district sales manager, lubrication engineer, Macmillan Petroleum Corp., Los Angeles.

Marquis, A. Nelson, tool planner, Lockheed Aircraft Corp., Burbank, Calif.

McLarren, Robert, service engineer, Northrop Aircraft, Inc., Hawthorne, Calif.

Morgan, Charles Sibley, foreman, salvage, Consolidated Vultee Aircraft Corp., San Diego, Calif.

Perl, A. R., assistant chief engineer, Aircraft Components, Inc., Van Nuys, Calif.

Rager, William Henry, junior stress analyst, Ryan Aeronautical Co., San Diego, Calif.

Russel, George M., field service representative, Vega Aircraft Corp., Burbank, Calif.

Tinker, H. E. W., manager, altitude equipment division, AiResearch Mfg. Co., Los Angeles.

Visel, Morlan A., engineering laboratory, Vega Aircraft Corp., Burbank, Calif.

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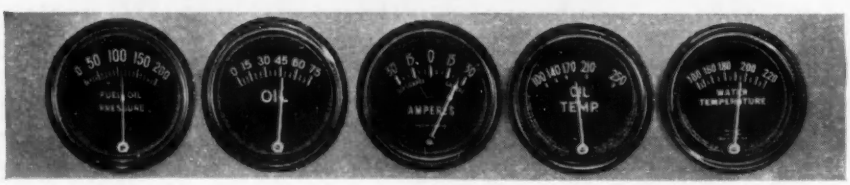

Wallace, J. H., chief engineer, Pacific Enterprise Products Co., Los Angeles.

Wills, John A., experimental engineer, Photogrammetric Instruments, Pasadena, Calif.

Southern New England Section

Brown, Walter Earl, service engineer, Indian Motocycle Co., Springfield, Mass.

Sorant, Edward, draftsman, Pratt & Whitney Aircraft, division of United Aircraft Corp., East Hartford, Conn.

Southern Ohio Section

Cary, W. W., Jr., foreman, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Lockland, Ohio.

Elsbernd, Carl Albert, leadman, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Lockland, Ohio.

Golden, William, layout draftsman, The National Supply Co., Springfield, Ohio.

Howard, T. W., Jr., 1st Lt., U. S. Army Air Forces, Wright Field, Dayton, Ohio.

Lahners, Warren, engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Lockland, Ohio.

Larwa, Joseph Franklin, draftsman, National Supply Co., Springfield, Ohio.

MacDonald, Charles M., engine test inspector, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Lockland, Ohio.

Maletz, Joseph F., specifications engineer, National Supply Co., Springfield, Ohio.

Wolfe, Harold C., secretary and treasurer, Gramm Truck & Trailer Corp., Delphos, Ohio.

Syracuse Section

Smith James J., production engineer, War Department, Rochester Ordnance District, Syracuse, N. Y.

Texas Section

Muerdter, Fred R., automotive technician, War Department, U. S. Civil Service, Fort Bliss, Texas.

Owen, Holt E., sales manager, East Texas Auto Supply Co., Tyler, Texas.

Schenewerk, J. F., Jr., experimental tool engineer, Continental Motors Corp., Garland, Texas.

Washington Section

Besore, Jay, manager service department, Briggs Clarifier Co., Washington, D. C.

Cook, Calvin E., mechanical engineer, War Department, Corps of Engineers, Supply Division, Washington, D. C.

Rauschenberg, Clarence Henry, automotive analyst, War Department, U. S. Army & Navy Munitions Board, Automotive Division, Washington, D. C.

Sosa, Peter J., mechanical engineer, Engineering & Research Corp., Riverdale, Md.

Wichita Section

Clark, John J., assistant chief engineer, Wichita Division, Boeing Airplane Co., Wichita.

Rademacher, Otto Albert, automotive adviser, U. S. Army, 94th Division Hdqs., APO 94, Camp Phillips, Kansas.

Outside of Section Territory

Bennett, George D., assistant customer engineer, Bendix Aviation Corp., South Bend, Ind. Mail: 1105 Hester St., Elkhart, Ind.

Chadwick, George Arthur, Jr., Major, U. S. Army, Hq. 79th Infantry Division, APO 70, c/o Postmaster, Nashville, Tenn.

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Applications Received

continued from page 62

Eschweiler, **Bernard Ralph,** experimental engineer, Minneapolis-Moline Power Implement Co., Minneapolis, Minn.

Fellows Gear **Shaper Co.,** Springfield, Vermont.

Grater, Alfred E., sales engineer, Clark Equipment Co., Berrien Springs, Mich.

Jeide, Rex **Franklin,** experimental engineer, Minneapolis-Moline Power Implement Co., Minneapolis, Minn.

Kelland, Herbert Harold, Engineer, Canadian Pacific Air Lines, Ltd., Vancouver, B. C., Canada.

Lee, Albin L., mechanical draftsman, Minneapolis-Moline Power Implement Co., Minneapolis, Minn.

Lindeman, Myrl, instructor, mechanical engineering department, University of Minnesota, Minneapolis, Minn.

Moulton, Parker N., Jr., 2nd Lt., U. S. Army, 27th Infantry Training Battalion, Camp Croft, S. C.

Richter, Rollin D., 2nd Lt., U. S. Army 27th Infantry Training Battalion, Camp Croft, S. C.

Rostas, Steven M., assistant in department of physics, Amherst College, Amherst, Mass.

Stoddard, Edgar A., Major, U. S. Army, Ordnance Automotive School, Atlanta Ordnance Depot, Atlanta, Ga.

Wharton, Herbert Lee, foreman transportation, USN Air Station, Pearl Harbor, T. H.

Williams, William F., 2nd Lt., U. S. Army, 27th Infantry Training Battalion, Camp Croft, S. C.

Foreign

War Department, Government of India, New Delhi, India.

SAE Coming Events

May 5-6 — **SAE National Transportation and Maintenance Meeting**
Pennsylvania Hotel—New York

June 2-3 — **SAE Diesel Engine and Fuels and Lubricants Meeting**
Carter Hotel—Cleveland
(Auspices of Diesel-Engine Activity, Fuels & Lubricants Activity and Cleveland Section.)

June 9-10 — **SAE War Materiel Meeting**
Book-Cadillac Hotel—Detroit
(Auspices of Truck and Bus Activity, Passenger-Car Activity, Production Activity and Detroit Section.)

Baltimore – May 13

Engineers Club; dinner 6:30 p.m. Piston Rings – Leonidas Doty, Jr., engr. in charge, automotive division, American Hammered Piston Ring Division, Koppers Co.

Canadian – May 7

Prince Edward Hotel, Windsor, Ont.; dinner 7:00 p.m. Aspects of the Automotive Industry's Response to the Challenge of Global War – A. W. Herrington, chairman of the board, Marmon-Herrington Co., Inc.

Chicago – May 11 and 18

May 11 – Hotel Knickerbocker, Chicago; dinner 6:30 p.m. Navy Night Program. Aircraft Carrier Operation – Com. G. A. T. Washburn, Commanding Officer, U. S. Naval Air Station, Glenview.

May 18 – Turner Hall, South Bend, Ind. Airflow Meters – R. E. Sprenkle, Bailey Meter Co.

Colorado Group – May 11

Dean Gillespie & Co., Denver. History of Truck Industry.

Metropolitan – May 20

Hotel Edison, New York; dinner 6:30 p.m. Future of Aviation – Ralph Damon, president, Republic Aviation Corp.

Milwaukee – June 4

Westmoor Country Club; dinner 6:30 p.m. Annual Ladies Night. Speaker to be announced.

New England – May 13

Engineers Club, Boston; dinner 6:30 p.m. Speaker to be announced.

Northern California – May 11

Hotel Leamington, Oakland; dinner 6:00 p.m. Formation and Control of Ring Belt Deposits – G. H. Denison.

Oregon – May 21

Lloyds Golf Club; dinner 6:30 p.m. Subject: Superchargers – Construction and Maintenance.

Philadelphia – May 12

Engineers Club; dinner 7:00 p.m. Coffee talk – Radio Goes to War – Mrs. William H. Corwith. Farm Chemurgy – Wheeler McMillen, editor-in-chief, *Farm Journal*.

Southern California – May 14 and 28

May 14 – San Diego Hotel, San Diego; dinner 6:30 p.m. Aircraft Meeting.

May 28 – Clark Hotel, Los Angeles; dinner 6:30 p.m. Diesel Engine Meeting.

Syracuse – No meeting

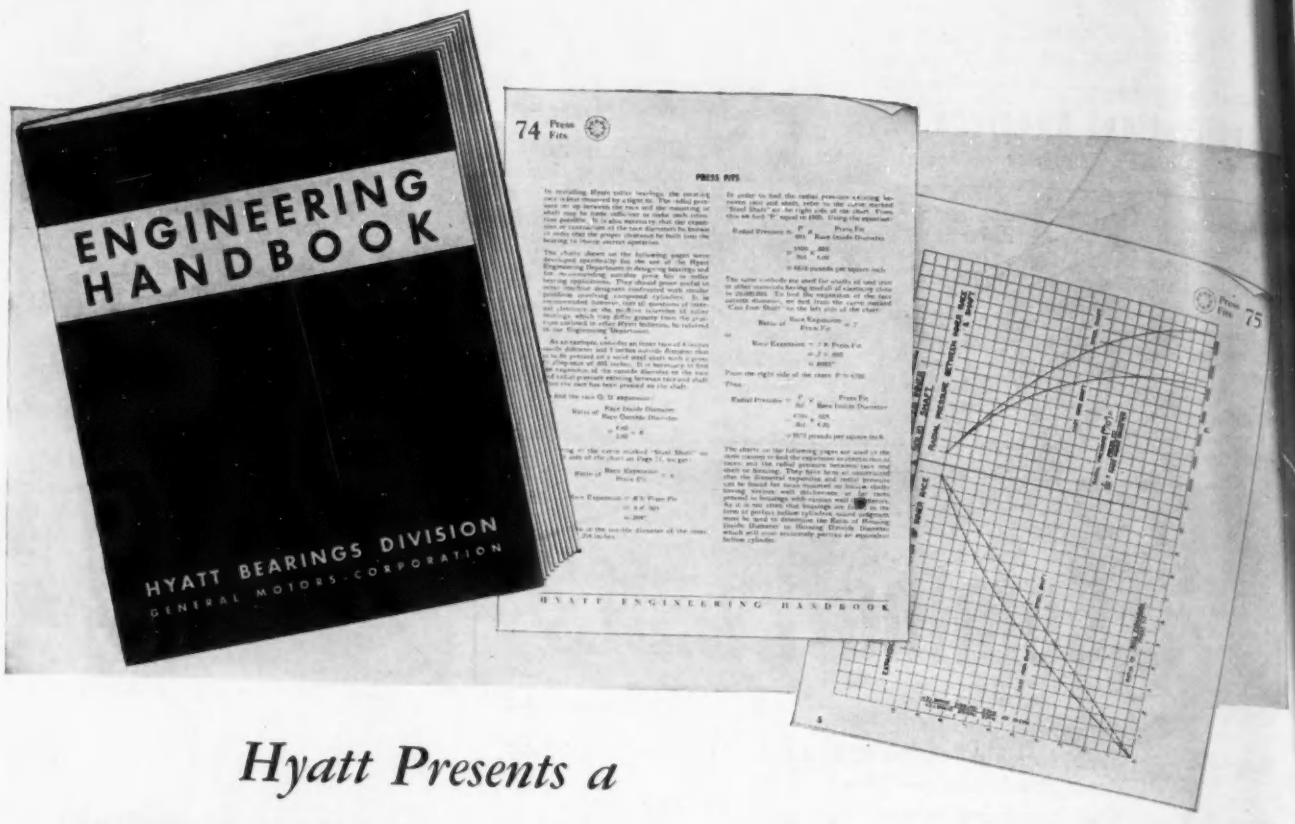
Texas – May 7

SAE Texas Section participation in 1943 Texas Aviation Conference, A. & M. College of Texas, College Station. Dinner 6:30 p.m. Speaker – William B. Stout, Stout Research Laboratories of Consolidated Aircraft Corp. Evening meeting: Aeronautic Standards for Victory – J. D. Redding, staff representative, aeronautical activities, SAE.

Wichita – May 5

Place to be announced; dinner 6:30 p.m. Selection and Installation of Aircraft Propellers – Thomas B. Rhines, assistant engineer, Hamilton Standard Propeller Div., United Aircraft Corp. Aeronautic Standards for Victory – J. D. Redding, staff representative, aeronautical activities, SAE.

MEMBERS OF SAE ENGINE COMMITTEE E-4 ON SPARK PLUGS, IGNITION SHIELDING, AND IGNITION CABLE, meeting during the SAE National Aeronautic Meeting, had just completed a standard on sealing compound, and swung into a project on quench bomb tests. The committee has completed two Aeronautical standards and three Aeronautical materials specifications. Seated, L. to R.: E. K. Von Mertens, Pratt & Whitney Aircraft; A. L. Beall, Wright Aeronautical Corp., chairman; E. W. Rentz, Jr., SAE staff representative; and B. Clements, Wright Aeronautical Corp. Standing, L. to R.: J. K. Rudd, Wright Aeronautical Corp.; P. T. Nims, Chrysler Corp.; Max Epps, Ranger Aircraft Engine Division, and J. L. Arthur, Allison Division



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